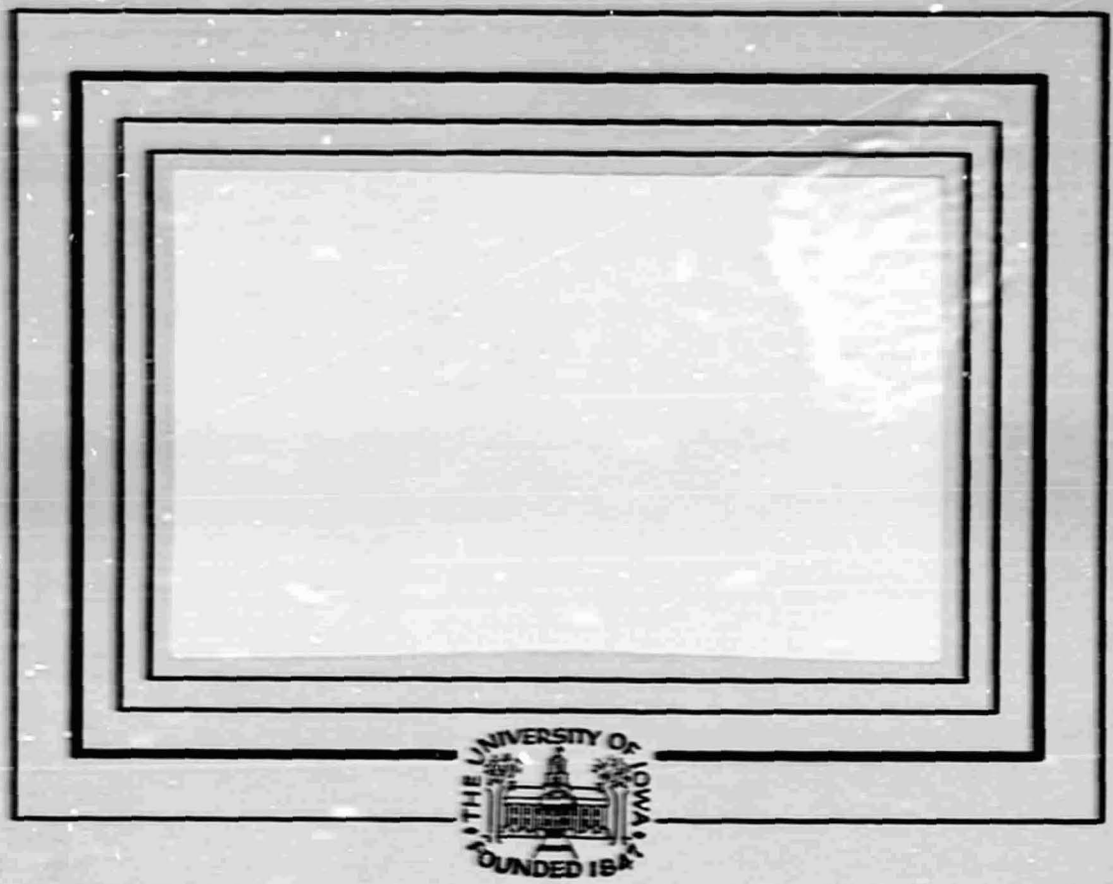
NASA CR-160023



Department of Physics and Astronomy

THE UNIVERSITY OF IOWA

Iowa City, Iowa 52242

IMP-8 FINAL REPORT

Volume One

E. M. Field Experiment

NASA Contract NAS5-11431

May, 1980

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LIST OF FIGURES

LIST OF TABLES

1.0 MECHANICAL CONFIGURATION

The E. M. fields experiment on IMP-J uses two electric dipole antennas and a triaxial search coil magnetic antenna to sense the electric and magnetic field of plasma waves in space. The configuration of these antennas on the spacecraft is shown in Figure 1.1. The electric dipole antennas consist of a fine wire, 0.021 inches in diameter, with a nominal extended tip-to-tip length of 400 ft. The outermost 50 ft. of each element is conducting and the rest of the antenna is covered with an insulating coating.

The search coil antennas each consist of a high μ core with two separate windings of 40,000 turns each to sense A. C. magnetic fields. The search coils have a length of 18 inches tip-to-tip and are mounted on the end of a boom as shown in Figure 1.1. The axes of the x' and y' search coil antennas are parallel to the x' and y' electric antenna axes.

The spacecraft rotates in the right hand sense with respect to the +z axis at a nominal rate of 24 r. p. m. In orbit the +z axis is directed toward the south ecliptic pole.

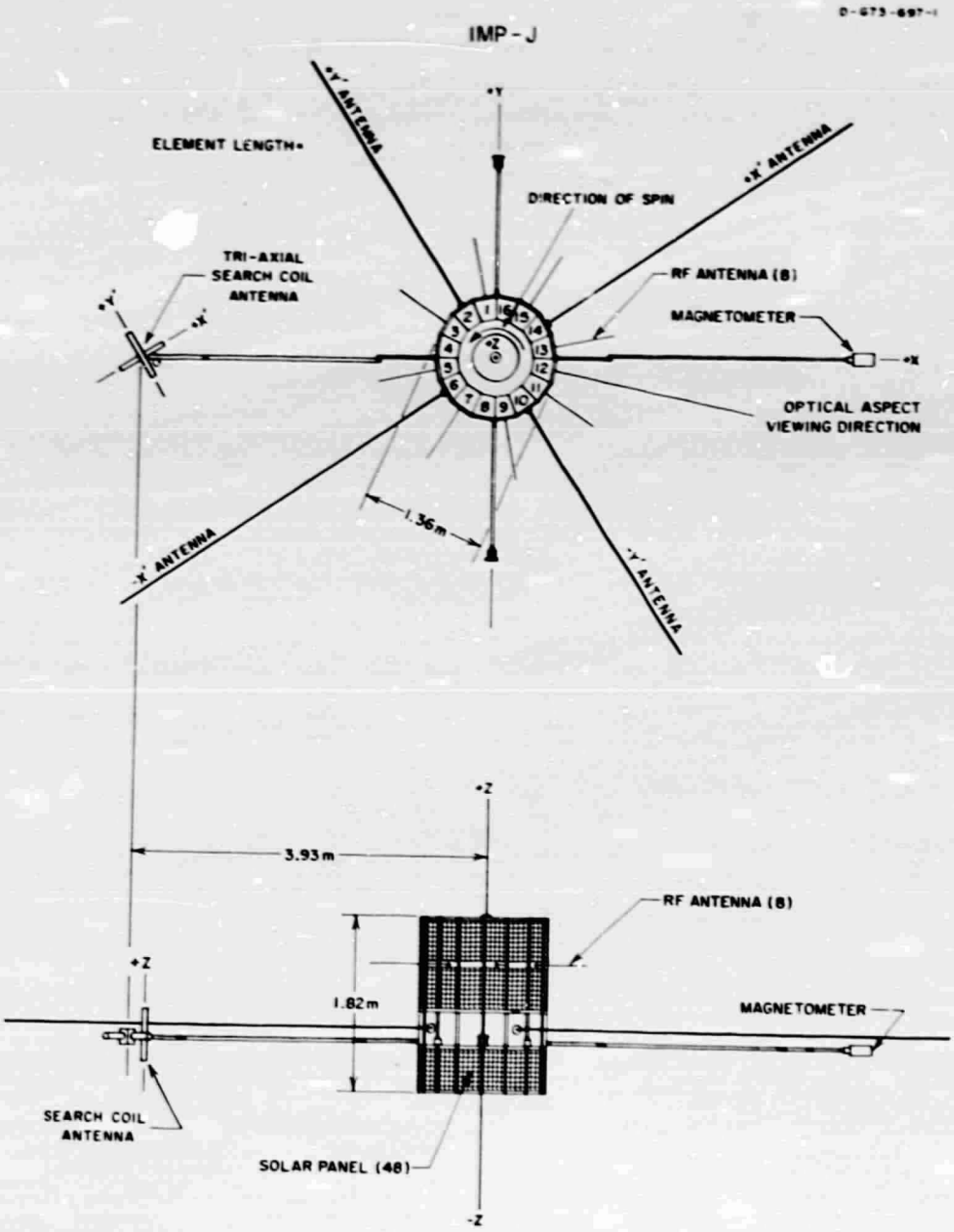

IMP - J
ELEMENT LENGTH=
+Y ANTENNA
+Y
-X ANTENNA
DIRECTION OF SPIN
+X ANTENNA
TRI-AXIAL
SEARCH COIL
ANTENNA
RF ANTENNA (8)
MAGNETOMETER
+X
OPTICAL ASPECT
VIEWING DIRECTION
1.36m
-X ANTENNA
-Y ANTENNA
+Z
3.93m
RF ANTENNA (8)
+Z
1.82m
MAGNETOMETER
SEARCH COIL
ANTENNA
SOLAR PANEL (48)
-Z

Figure 1.1

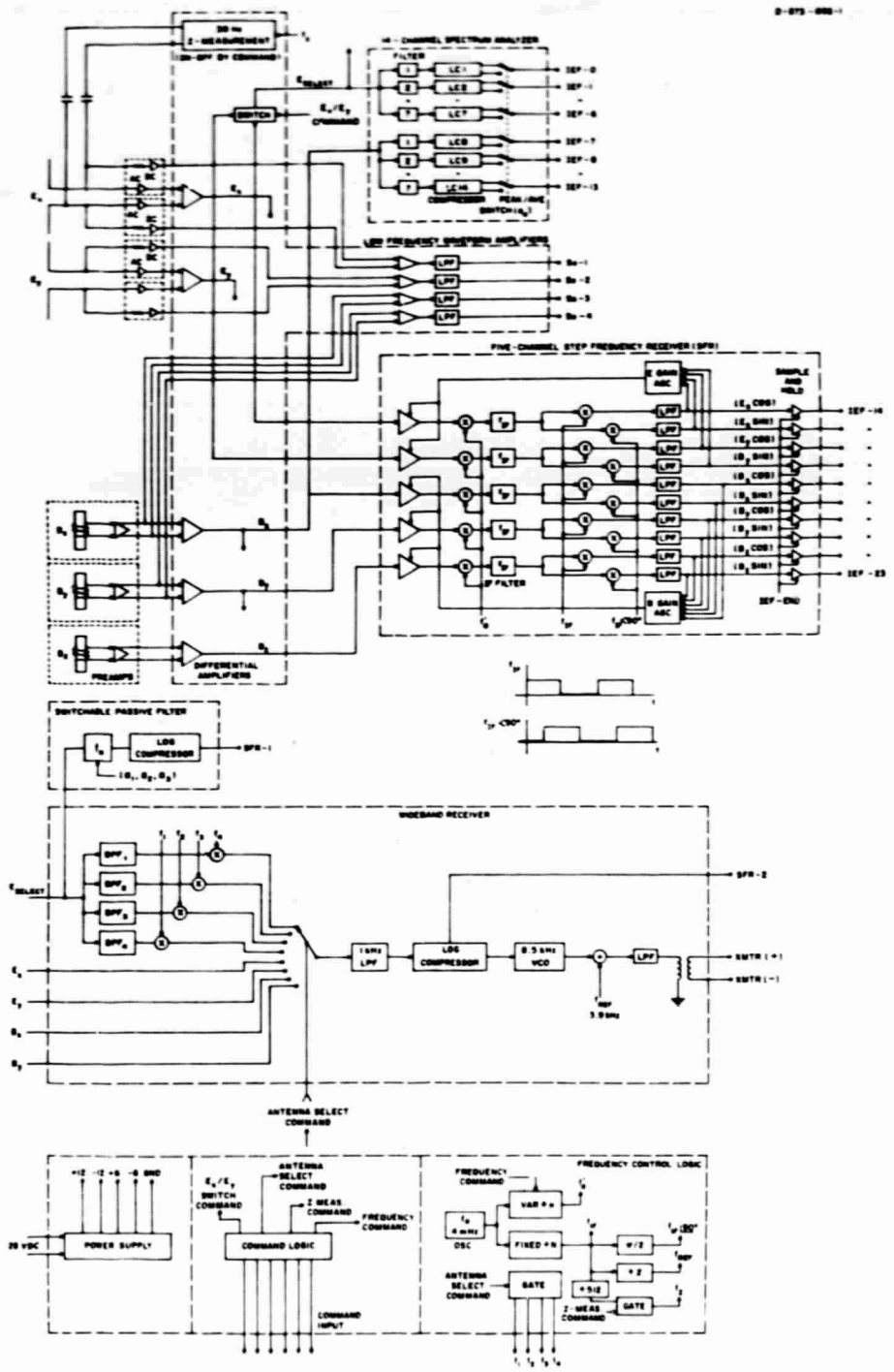

FIVE-CHANNEL STEP FREQUENCY RECEIVER (SFR)
SWITCHABLE PASSIVE FILTER
LOG COMPRESSOR
SFR-1
WIDEBAND RECEIVER
SFR-2
1 kHz LPF
LOG COMPRESSOR
8.5 kHz VCO
LPF
XMTR (+)
XMTR (-)
5.9 kHz
ANTENNA SELECT COMMAND
POWER SUPPLY
+12 -12 +5 -5 GND
20 VDC
COMMAND LOGIC
COMMAND INPUT
FREQUENCY COMMAND
FREQUENCY CONTROL LOGIC
VAR ÷ n
FIXED ÷ N
GATE
÷2
÷512
OSC
4 mHz
Z-MEAS COMMAND

Figure 2.1

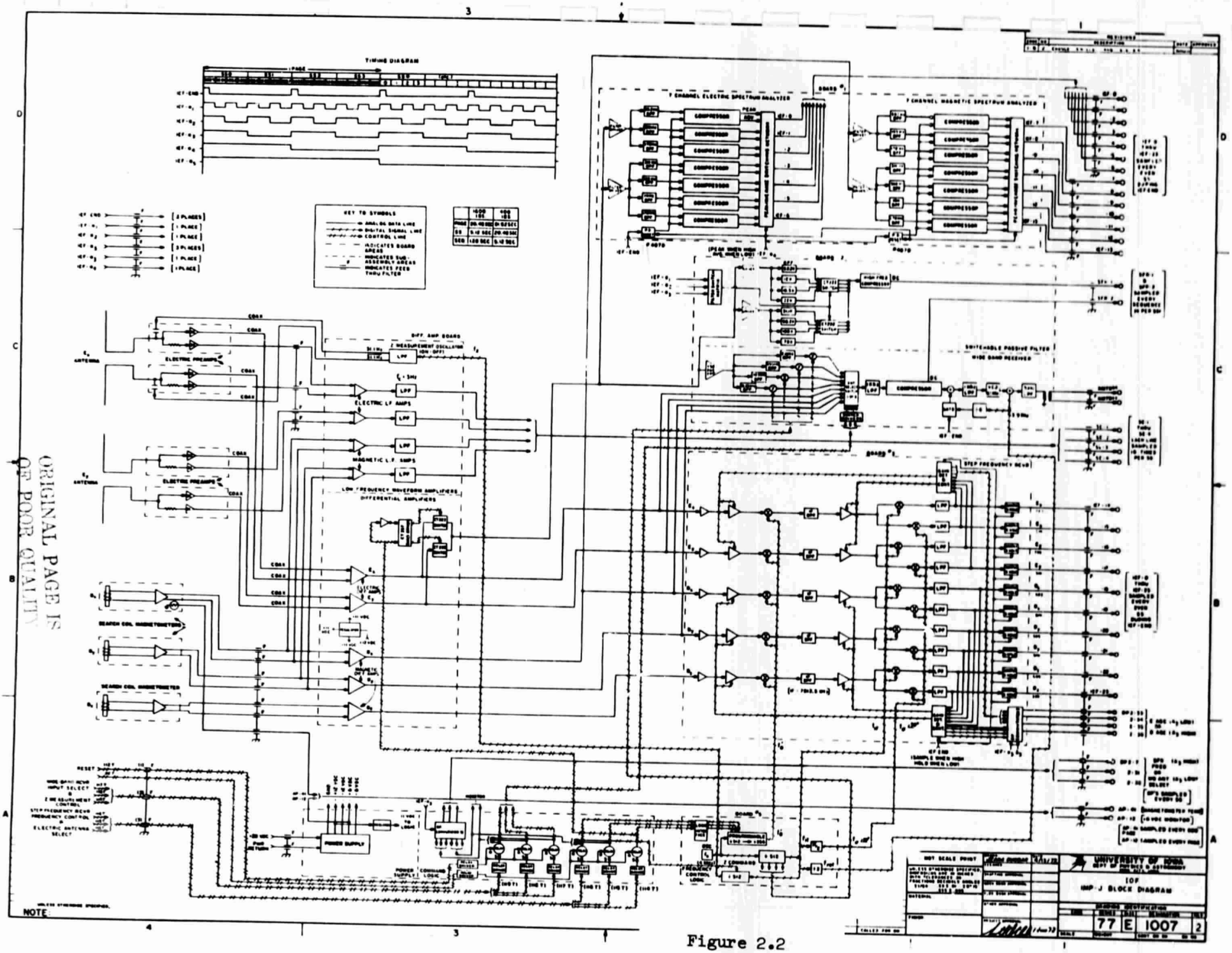
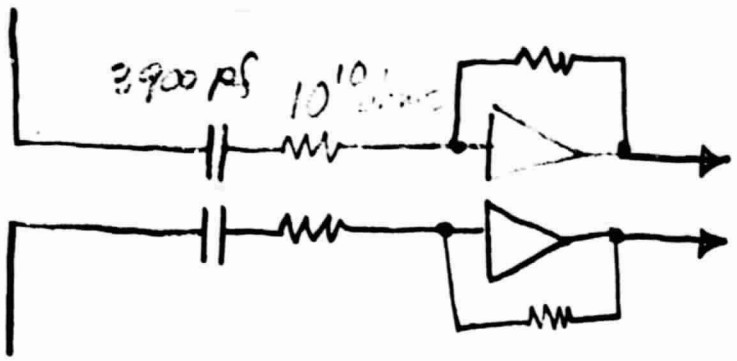


Figure 2.2

the electric fields in the plasma) to differential amplifiers in the main electronics housing. The A. C. preamplifier has an essentially flat frequency response from 10 Hz to 2 MHz. The D. C. preamplifier is capacitively coupled to the antenna through a 3900 pf capacitance. The frequency pass band (3 db points) of the D. C. preamplifier is from 4.0×10^{-3} to 4.0 Hz. This pass band includes the nominal 0.4 Hz spin frequency of the spacecraft. The input impedance of the D. C. preamplifier is 10^{10} ohms (see circuit diagram below)



2.2 Magnetic Preamplifiers

Three orthogonal search coil magnetometers are used. Each search coil has two separate windings of number 47 copper wire with 40,000 turns per winding. Each winding is connected to a separate preamplifier so that there are two preamplifiers for each search coil axis. The polarities of the two windings are arranged so that the two preamplifier outputs are 180° out of phase thereby providing a

balanced pair (+V and -V) of output voltages from each search coil sensor. These balanced voltages go to a differential amplifier in the main experiment package similar to the differential amplifiers used for the electric antennas.

2.3 Differential Amplifiers

Five differential amplifiers (all identical) are located in the main instrumentation package to receive signals from the antenna preamplifiers. These differential amplifiers convert the balanced differential signals from the antennas to single-ended signals.

The E_x, E_y, B_x, and B_y outputs are routed to the Step Frequency Receiver and the wide-band receiver, with B_x also being routed to the magnetic field spectrum analyzer. The B_z output is only connected to the step frequency receiver.

The E_x and E_y outputs are switched (by command) to form E_{select}, which goes to the wide-band receiver, the switchable passive filter receiver, and the electric field spectrum analyzer.

2.4 Fourteen-Channel Spectrum Analyzer

Two identical seven-channel spectrum analyzers are used to determine the electric and magnetic field spectral densities in the frequency range from 20 Hz to 2.0 kHz. Each spectrum analyzer consists of seven bandpass filters each followed by a log compressor. The center frequencies and bandwidths of the filters are listed in Table 2.1 and the frequency response of the filters is shown in Figure 2.3.

Table 2.1

Spectrum Analyzer Channel Numbers and Frequencies

Channel Number	Antenna	Center Frequency	Bandwidth	Encoder Read-out
1	Ex/Ey	40.0 Hz	±30%	IEF-0
2	Ex/Ey	100.0 Hz	±15%	IEF-1
3	Ex/Ey	178.0 Hz	±15%	IEF-2
4	Ex/Ey	311.0 Hz	±15%	IEF-3
5	Ex/Ey	562.0 Hz	±15%	IEF-4
6	Ex/Ey	1.0 kHz	±15%	IEF-5
7	Ex/Ey	1.78 kHz	±15%	IEF-6
1	Bx	40.0 Hz	±30%	IEF-7
2	Bx	100.0 Hz	±15%	IEF-8
3	Bx	178.0 Hz	±15%	IEF-9
4	Bx	311.0 Hz	±15%	IEF-10
5	Bx	562.0 Hz	±15%	IEF-11
6	Bx	1.0 kHz	±15%	IEF-12
7	Bx	1.78 kHz	±15%	IEF-13

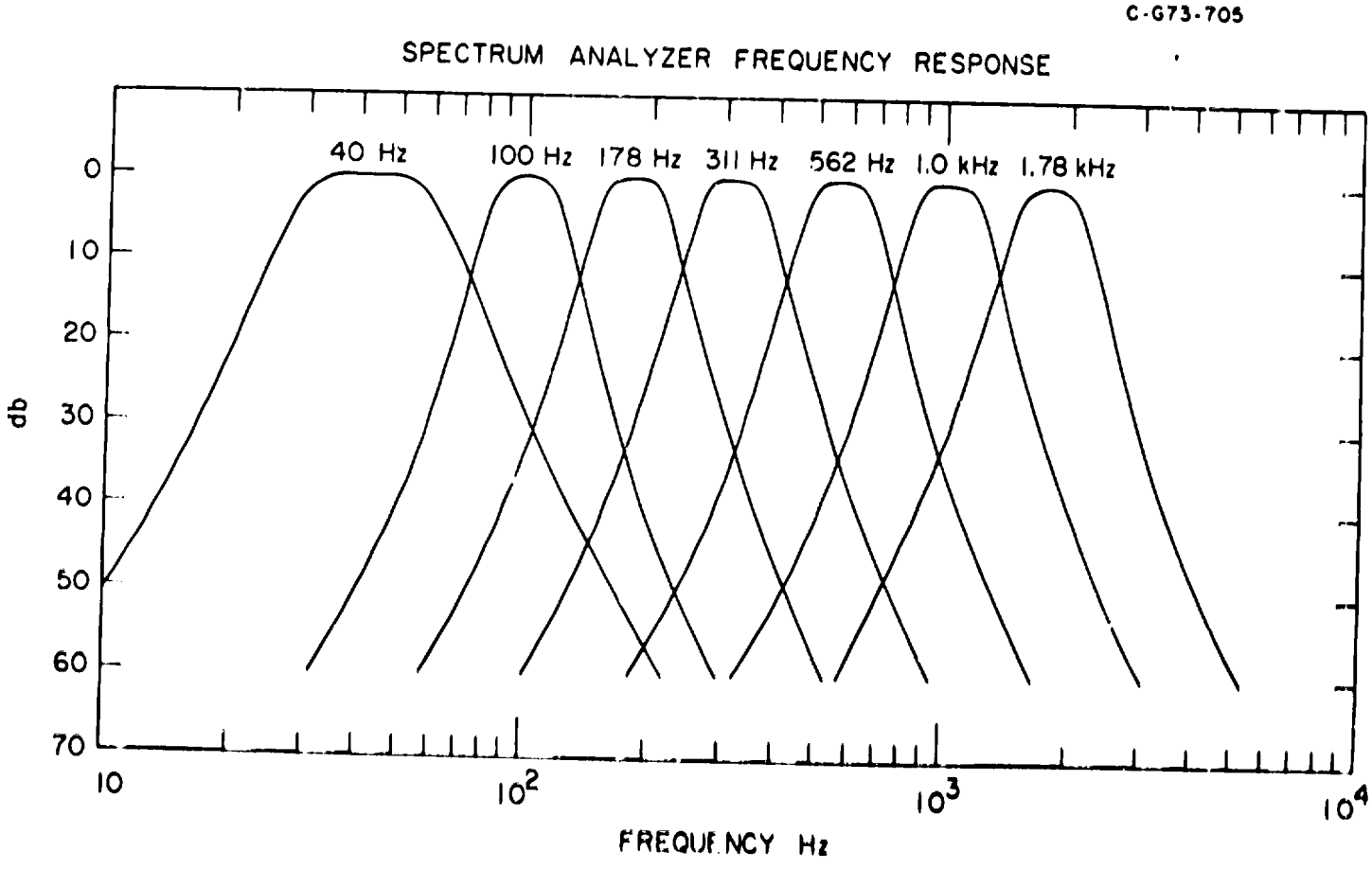

C-G73-705
SPECTRUM ANALYZER FREQUENCY RESPONSE
40 Hz
100 Hz
178 Hz
311 Hz
562 Hz
1.0 kHz
1.78 kHz
0
10
20
30
40
50
60
70
db
10
10^2
10^3
10^4
FREQUENCY Hz

Figure 2.3

Each log compressor has a dynamic range from 10_{μ} volts to 1.0 volt r. m. s. and produces a 0.0 to 5.0 volt output proportional to the logarithm of the input signal strength. The output of each log compressor is assigned to an analog data line of the spacecraft encoder. These analog data lines are identified as IEF-0, IEF-1, ---, to IEF-13, and are A/D converted by the spacecraft encoder with approximately 8-bit accuracy. The IEF outputs from the log compressors are internally commutated between a peak and an average measurement. The peak output is sampled and reset every 20.48 sec. in the high data rate mode (81.92 sec. in the low data rate mode). The detailed timing relations involved in this sampling are discussed in the section on timing. The average output has a time constant of 0.1 sec. and is also sampled once every 20.48 sec. in the high data rate mode (81.92 sec. in the low data rate mode).

2-5 Low-Frequency Waveform Amplifiers

Four low frequency waveform amplifiers are used to condition low frequency (4.0×10^{-3} to 4.0 Hz) signals from the $V_{x'}$, $E_{y'}$, $B_{x'}$, and $l_{y'}$ antennas. The $E_{x'}$ and $E_{y'}$ measurements will be used to determine static electric fields in space from the spin modulated of these outputs. The four low-frequency waveform outputs are sampled and A/D converted (8-bit accuracy) by the spacecraft encoder. These analog outputs are labeled Se-1, Se-2, Se-3, and Se-4. The sampling scheme consists of taking one set of 16 equally spaced samples of all four outputs during a complete rotation of the spacecraft every 10.24 seconds. The gains of the electric field waveform

Channels are approximately 0.c. The maximum potential difference which can be detected without saturation is therefore ± 2.0 volts (equivalent to a static electric field of ~ 2.0 volts/100 meters ~ 20 mV/meter). (See calibration section for precise values.) The A/D converter quantizing step size is 1/200 of 5.0 volts so the minimum detectable electric field step is 0.2 mV/m.

2.6 Synchronous Five-Channel Step Frequency Receiver

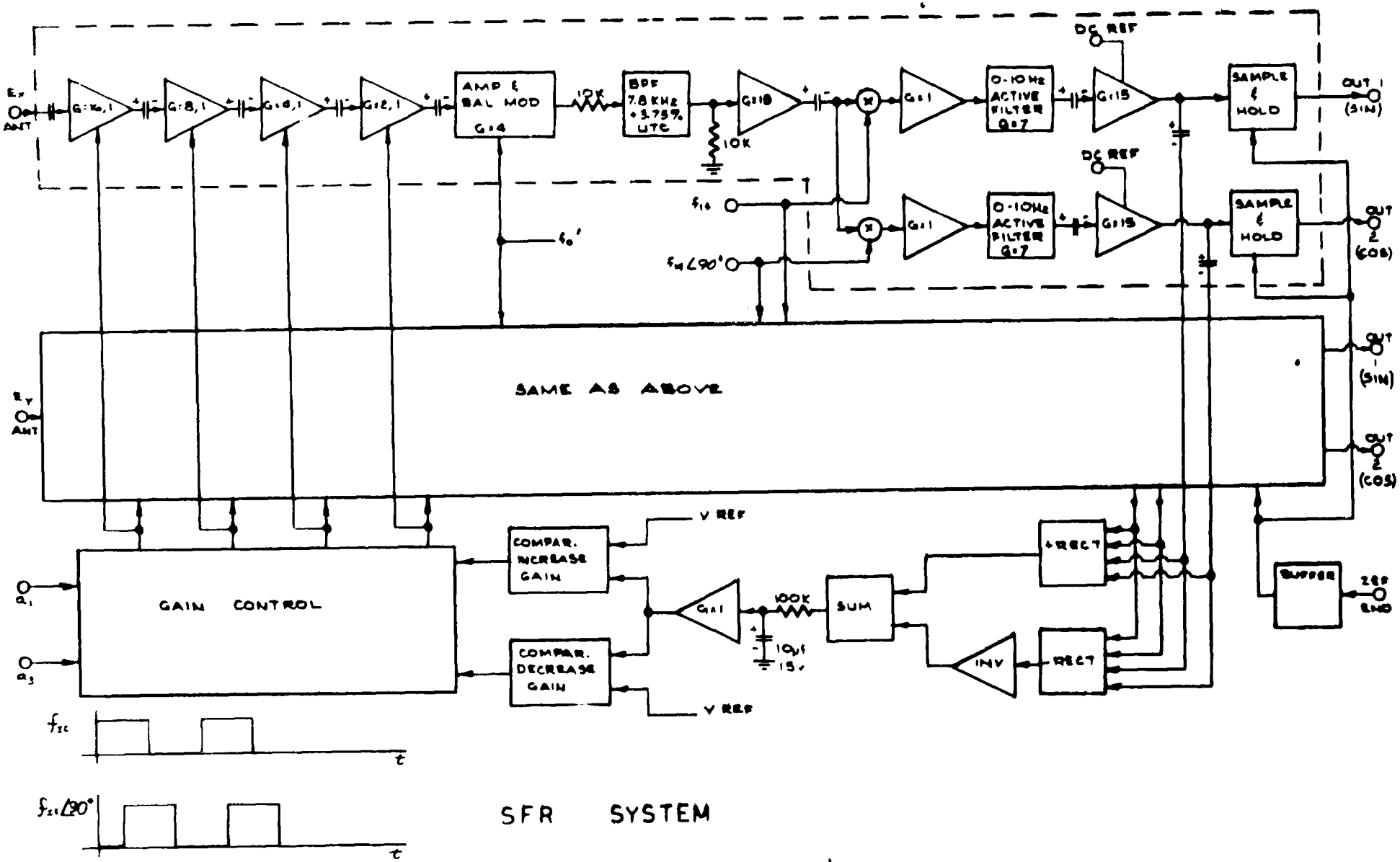
A tunable five-channel double conversion receiver is used to obtain simultaneous waveform information from 30 Hz to 3 kHz. The conversion frequencies for these five channels, $f_{o'}$ and f_{IF} (see Figures 2.1 and 2.4), are derived from the same source to preserve the relative phase of signals in each of the five channels. The conversion frequencies $f_{o'}$ and f_{IF} are obtained by counting down from a crystal oscillator which is at a nominal frequency of f_o = 4.0 MHz. The receiver center frequency is given by

$$f = f_{o'} - f_{IF} ;$$

where $f_{o'} = f_o/n$ and $f_{IF} = f_o/N$, so that

$$f = f_o \left(\frac{1}{n} - \frac{1}{N}\right) .$$

The dividing ratio N = 512 is fixed, giving f_{IF} = 7812.5 Hz, and the dividing ratio n is controlled by command, as shown in Table 2.2. The second frequency conversion at f_{IF} is performed by using two conversion signals shifted by 90° in phase. This second



SFR SYSTEM

Figure 2.4

Table 2.2

SFR Frequencies

Frequency	Commands*			n
	114T	115T	116T	
30.6 Hz	0	0	0	510
61.5	1	0	0	508
124.0	0	1	0	504
252.0	1	1	0	496
520.8	1	0	1	480
1116.0	1	0	1	448
1802.0	0	1	1	416
2604.0	1	1	1	384

*Reset by command 112T

conversion beats the received signal to approximately zero frequency and provides two outputs per receiver channel proportional to the cosine and sine Fourier coefficients of the received signal at frequency f. The bandwidth of the receiver is determined by a 0-10 Hz active filter after the second conversion. The cosine and sine outputs of each channel are sampled and held by sample and hold circuits in the experiment. The 10 voltages representing the cosine and sine outputs from all five antennas are A/D converted and transmitted as IEF-14 through IEF-23 once every 10.24 seconds in the high data rate mode (see Table 2.3). The cosine and sine outputs of all channels have a fixed bias voltage of about 2.5 volts which must be subtracted from the transmitted voltage. The cosine and sine outputs can be used for complex representations of observed waveforms according to the relations

$$E_x(t) = \mathrm{Re}\left\{\tilde{E}_x e^{-i\omega t}\right\}$$

where $\tilde{E}_x = (E_x \text{ cosine}) + i(E_x \text{ sine})$.

It is then possible to compute time average quantities, $\langle\ \rangle$, such as the polarization vector

$$\vec{P} = \frac{\vec{B}_x \frac{d\vec{B}}{dt}}{\left|\vec{B}_x \frac{d\vec{B}}{dt}\right|}$$

Table 2.3

Antenna	Output	Encoder Read-Out
Ex	Cosine	IEF-14
Ex	Sine	IEF-15
Ey	Cosine	IEF-16
Ey	Sine	IEF-17
Bx	Cosine	IEF-18
Bx	Sine	IEF-19
By	Cosine	IEF-20
By	Sine	IEF-21
Bz	Cosine	IEF-22
Bz	Sine	IEF-23

and Poynting flux

$$\vec{S} = \vec{E} \times \vec{H},$$

from complex relations such as

$$\langle \vec{P} \rangle = \frac{\mathrm{Re}\{ \tilde{\vec{B}} \times (-i\tilde{\vec{B}})^* \}}{|\mathrm{Re}\{ \tilde{\vec{B}} \times (-i\tilde{\vec{B}})^* \}|}$$

and $\langle \vec{S} \rangle = (1/2)\mathrm{Re}(\vec{E} \times \vec{H}^*)$.

The gains of the electric receiver channels and the magnetic receiver channels are controlled by two separate discrete gain control loops to maintain the output voltages at a level appropriate for 8-bit sampling by the encoding system. The gain control states are updated and transmitted once every 10.24 sec. (40.96 sec. in the low data rate mode) as digital performance parameters (DP). The gain states and corresponding DP codes are summarized in Table 2.4.

2.7 Switchable Passive Filter Receiver

An eight-channel step frequency receiver (referred to as the switchable passive filter receiver) is used to obtain electric field spectrum measurements in the frequency range from 5.6 kHz to 178 kHz. This receiver consists of a set of eight passive filters followed by a single channel log compressor. The filters are sequentially switched between the electric differential amplifier output and the log

Table 2.4

SFR Gain States

DP Code*				Gain
2-33; 34; 35; 36				
0	0	0	0	1
1	0	0	0	2
0	1	0	0	4
0	0	1	0	8
0	0	0	1	16
1	0	0	1	32
0	1	0	1	64
0	0	1	1	128
1	0	1	1	256
0	1	1	1	512
1	1	1	1	1024

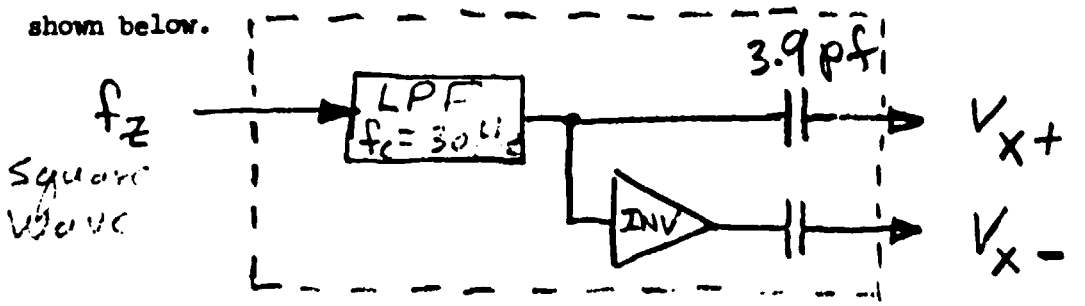
*Commutated between E Gain (when A_3 is low) and B Gain (when A_3 is high)

compressor one at a time. The switching is controlled by clock lines a_1, a_2, and a_3. In the high data rate one complete cycle of all eight channels is completed once every 10.24 seconds. The frequency response of the eight filter channels is shown in Figure 2.5. The center frequencies and corresponding a_1, a_2, a_3 clock line positions during which the log compressor is sampled are shown in Table 2.5. The time constant of the log compressor output is 0.05 seconds.

2.8 Impedance Measurement

The antenna impedance measurement consists of a 30.5 Hz sine wave which is capacitively coupled to the E_x antenna. This sine wave is turned on for 81.92 seconds every 10.9 minutes (C27 rate). The impedance measurement can be turned on or off by command. The impedance of the coupling capacitor (3.9 pf) is normally much larger than the antenna impedance so that the impedance measurement circuit effectively drives the antennas with an A. C. current which is 180° out of phase for the two antenna elements. The antenna impedance is then proportional to the A. C. voltage difference between the antenna elements, which can be determined from the 40 Hz channel of the E_x spectrum analyzer.

A block diagram of the impedance measurement drive circuit is shown below.



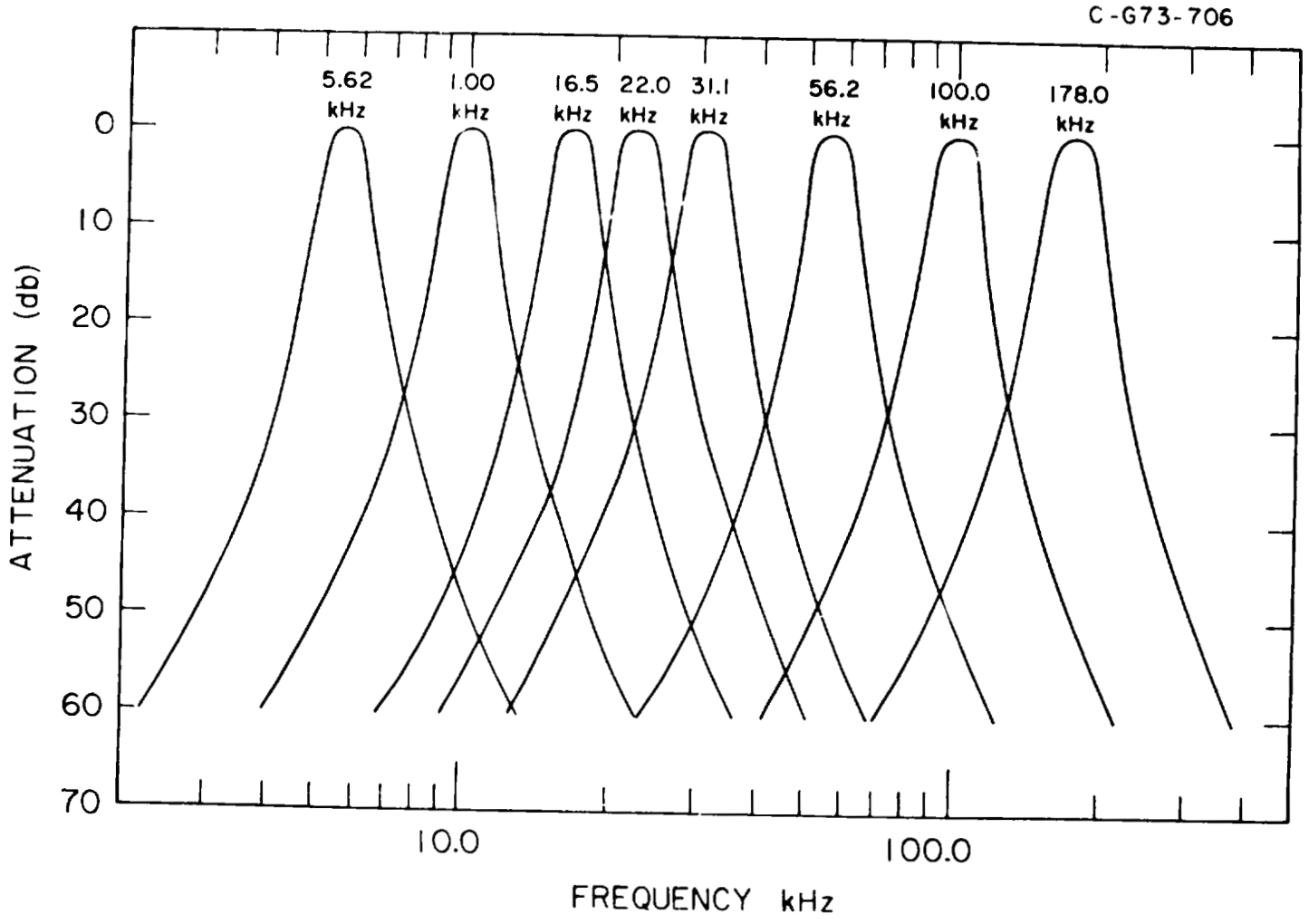

C-G73-706
5.62 kHz
1.00 kHz
16.5 kHz
22.0 kHz
31.1 kHz
56.2 kHz
100.0 kHz
178.0 kHz
0
10
20
30
40
50
60
70
ATTENUATION (db)
10.0
100.0
FREQUENCY kHz

Figure 2-5

Table 2.5

Frequency	Bandwidth	Clock Line a_1	a_2	a_3
5.62 kHz	±7.5%	1	1	1
10.0 kHz	±7.5%	0	1	1
16.5 kHz	±7.5%	1	0	1
22.0 kHz	±7.5%	0	0	1
31.1 kHz	±7.5%	1	1	0
56.2 kHz	±7.5%	0	1	0
100.0 kHz	±7.5%	1	0	0
178.0 kHz	±7.5%	0	0	0

2.9 Wideband Receiver

The wideband receiver on IMP-J consists of a 1 kHz low pass filter followed by a log compressor circuit as shown in Figure 2.1. The SFR-2 output from the log compressor is used to indicate the signal strength in this channel. The A. C. output of the log compressor has a non-linear (logarithmic) input-output characteristic to compress the amplitude variations of the input signal (~ 80 db) to a range (20 db) suitable for wide-band transmission. The A. C. output of the log compressor modulates an 8.5 kHz subcarrier which is transmitted to the ground by the analog (range and range rate) transmitter on IMP-J. The wideband receiver can be connected to any one of four antennas (E_x, E_y, B_x, or B_y) or can be used in a frequency conversion mode to receive signals from either the E_x or E_y antennas (determined by the E_x/E_y select switch) at a center frequency of either f_1 = 2.0 MHz, f_2 = 500 kHz, f_3 = 125.0 kHz, or f_4 = 31.25 kHz, as determined by command. In the frequency conversion mode the 0-1 kHz frequency spectrum out of the wide-band receiver gives the frequency difference between the received signal spectrum and the selected conversion frequency. The frequency conversion mode is mainly intended to allow IMP-J to be used as one leg of a long baseline interferometer at these frequencies. The conversion frequencies are obtained by dividing down the internal f_o = 4.0 MHz crystal oscillator (see Figure 2.1). To provide precise information on the frequency of this internal oscillator a reference frequency, $f_{Ref} = f_o/1024$, is also provided in the wide-band output.

2.10 Command Modes

The E. M. fields experiment has a total of nine commands, 112T through 119T. One of these commands 113T is the experiment power off command and does not connect to the experiment. The power on command, 112T, also acts as a reset command for three of the six latching relays used in the experiment (114T, 115T, 116T). 95T resets the other three latching relays (117T, 118T, 119T). Since the driver circuits for the latching relays are not energized when the experiment power is off, the latching relays are not reset by the initial power on command. The internal latching relays are set by commands 114T through 119T. The function of these commands is summarized in Table 2.6.

Table 2.6

Command Functions

Command	Function
95T	Reset (117T, 118T, 119T)
112T	Power On/Reset (114T, 115T, 116T)
113T	Power Off (not connected to exp.)

Command			Function	
114T	115T	116T	E_x/E_y Switch	SFR Frequency
0	0	0	E_x	30.6 Hz
1	0	0	E_y	61.5 Hz
0	1	0	E_x	124.0 Hz
1	1	0	E_y	252.0 Hz
0	0	1	E_x	520.8 Hz
1	0	1	E_y	1116.0 Hz
0	1	1	E_x	1802.8 Hz
1	1	1	E_y	2604.1 Hz

Command			Function	
117T	118T	119T	Z Measurement	Wide-Band Mode
0	0	0	Off	E_x
1	0	0	Off	E_y
0	1	0	Off	B_x
1	1	0	Off	B_y
0	0	1	On	2.0 MHz
1	0	1	On	500 kHz
0	1	1	On	125 kHz
1	1	1	On	31.125 kHz

3.0 TIMING AND ENCODER FORMAT

3.1 GSFC Encoder Interface Specs

INTERFACE WITH UNIV. OF IOWA ELECTRIC FIELD EXPERIMENT

THIS EXPERIMENT UTILIZES 90 8 BIT STORAGE REGISTERS (32 OF WHICH, ONLY THE 4 MOST SIGNIFICANT BITS ARE READ OUT) TO STORE 90 ANALOG TO DIGITALLY CONVERTED SAMPLES FOR A TOTAL OF 720 STORAGE BITS (OR 2x720 = 1440 DDP BITS)

THE INTERFACE CONSISTS OF 40 WIRES AND HAS A TRANSMITTED BIT RATE OF 12.5 KBPS @ 400 KBPS AND 50 KBPS @ 1600 KBPS

SINCE THE EXPERIMENT WILL ONLY FLY ON IMP J, THE TELEMETRY READ OUT DURING CH 8=D15 OF FR 0 IN ALL SEQUENCES WILL BE ZERO IN IMP H. THE SFR1 & SFR2 EQUALLY SPACED ANALOG SAMPLES, HOWEVER, WILL BE AVAILABLE IN IMP H & J SINCE THE AP OSCILLATOR IS USED FOR THEM.

SPECIFIED ANALOG INPUTS (LINES ① THRU ㉔)

THESE 24 ANALOG INPUT LINES ARE SAMPLED IN SPEC POSITIONS 16 THRU 39 (i.e. THE 16 GEF LINES ARE IN SPEC POSITIONS 0 THRU 15) TWICE PER PAGE. THEY ARE ALSO READ OUT TWICE PER PAGE FOR A TRANSMITTED BIT RATE OF

$24 \times 8 / 40.96 = 4.69$ KBPS @ 400 KBS OR

$4 \times 4.69 = 18.75$ KBPS @ 1600 KBS. EACH INPUT HAS THE STANDARD ANALOG INPUT CHARACTERISTICS DESCRIBED IN APPENDIX D.

SEE FIG #1 FOR SPEC SAMPLE TIMING. IT SHOULD BE NOTED THAT THE 40 SPECS TAKE 400 MS @ 1600 KBS BUT MAY TAKE 1600 MS @ 400 KBS DEPENDING ON HOW IT IS MECHANIZED.

THE EXACT READ OUT LOCATIONS ARE NOT KNOWN BUT WILL BE IN CH 8 & 15 OF FRO AND WILL BE FOUND ON THE FORMAT (GE-1281-507) AT SOME FUTURE DATE.
THE 24 SPEWED WIRES ARE CALLED IEF 0 THRU IEF 23.

SECTORED ANALOG INPUTS (LINES (25) THRU (28))

4 ea ANALOG LINES ARE SECTORED. THE LINES ARE CALLED IEF-SP1, IEF-SP2, IEF-SP3 & IEF-SP4. SEE FIGURES 1 & 4 FOR TIMING & NOMENCLATURE

THE 4 ea LINES ARE SECTORED BY 16, STARTING WITH THE FIRST SECTOR (1)16 THAT OCCURS AFTER SEQ 0 AND AFTER SEQ 8. THE SECTORING OCCURS OVER A SINGLE SPIN FOR A TOTAL OF 4X16 = 64 SAMPLES. TWO OF THE LINES (25) & (26) ARE READ OUT AS 8 BIT SAMPLES WHILE THE OTHER TWO, (27) & (28) ARE READ OUT AS 4 BIT SAMPLES. ONLY ONE OF THE SPINS ARE READ OUT EACH PLACE THE THE FOLLOWING IBPS RESULT:

	@400 IBS	@1600
(25) = IEFSP-1 =	8×16/81.92 = 1.56	4×1.56
(26) = IEFSP-2 =	8×16/81.92 = 1.56	4×1.56
(27) = IEFSP-3 =	4×16/81.92 = 0.78	4×0.78
(28) = IEFSP-4 =	4×16/81.92 = 0.78	4×0.78
TOTAL	= 4.69 IBS	= 18.75 IBS

THE SAMPLING OF THE 4 EQ LINES WILL BE OVER IN 40 MS $\begin{matrix}-0\\+20\text{MS}\end{matrix}$ FROM THE START OF ANY GIVEN SECTOR. THE ORDER OF SAMPLING IN A GIVEN SECTOR WILL BE AS SHOWN ON FIG #4.

EACH OF THE 4 LINES HAS THE STANDARD ANALOG INPUT CHARACTERISTICS AS DESCRIBED IN APPENDIX D.

THE EXACT READOUT LOCATIONS ARE NOT KNOWN BUT WILL BE IN CH 8 W/S OF FRO AND WILL BE FOUND ON THE FORMAT (GE-1281-507) AT SOME FUTURE DATE.

EQUALLY SPACED ANALOG SAMPLES (LINES (29) & (30))

THESE ANALOG INPUT LINES ARE SAMPLED IN THE SECOND HALF OF EVERY SEQUENCE FOR A TRANSMITTED BIT RATE OF $2\times8/5.12 = 3.13$ IBS @ 400 IBS OR $2\times8/1.28 = 12.5$ IBS @ 1600 IBS. THE 2 EQ LINES TO HAVE THE STANDARD ANALOG INPUT CHARACTERISTICS DESCRIBED IN APPENDIX D.

THOSE LINES WILL BE READ OUT IN CH 6 & 7 OF FRO OF ALL SEQUENCES AND WILL BE AVAILABLE IN BOTH IMPS H & J.

SEE FIGURE #1 FOR SAMPLE TIMES.

SUMMARY OF INPUTS

TYPE INPUTS	# OF INPUTS	# OF SPEED WORDS	IBS RO @ 400 IBS	IBS RO @ 1600 IBS
SPEEDED	24	24	≈ 4.69	18.75
SECTORED	4	64	≈ 4.69	18.75
ESAS	2	2	≈ 3.13	12.50
TOTALS	30	90	≈ 12.51	50.00

ENCODER TIMING SIGNALS (31) THRU (38)

THE PERIOD OF THE FOLLING LINES IS A FUNCTION OF BIT RATE. PERIODS IN SECONDS MAY BE FOUND ON GE-1281-450 SH #2. ALL LINES HAVE THE STANDARD OUTPUT CIRCUIT DESCRIBED IN APPND 1&C THUS +V ≅ +7.5V @ 56K & -V ≅ GRD @ 112K.

(31) IEF-END: +V DURING FRO=07 OF SEQ 0 & 8
-V ALL OTHER TIMES (SEE FIG #1)

(32) IEF-a_1: 2~/SS (SEE FIG #1)

(33) IEF-a_2: 1~/SS (")

(34) IEF-a_3: 2~/PAGE (")

(35) IEF-a_4: 1~/PAGE (")

(36) IEF-a_5: 1~/2 PAGES

(37) IEF-a_6: 1~/4 PAGES = 1~/ALBUM

(38) IEF-b: +7.75V @ 56K IF 400 IBS
GRD @ 112K IF 1600 IBS

FIXED PERIOD TIMING SIGNALS (LINES (39) → (41))

THE PERIOD OF THOSE SIGNALS DO NOT CHANGE AS A FUNCTION OF BIT RATE. THEY ARE APPROXIMATE SQUARE WAVES WITH STANDARD OUTPUT IMPEDANCES

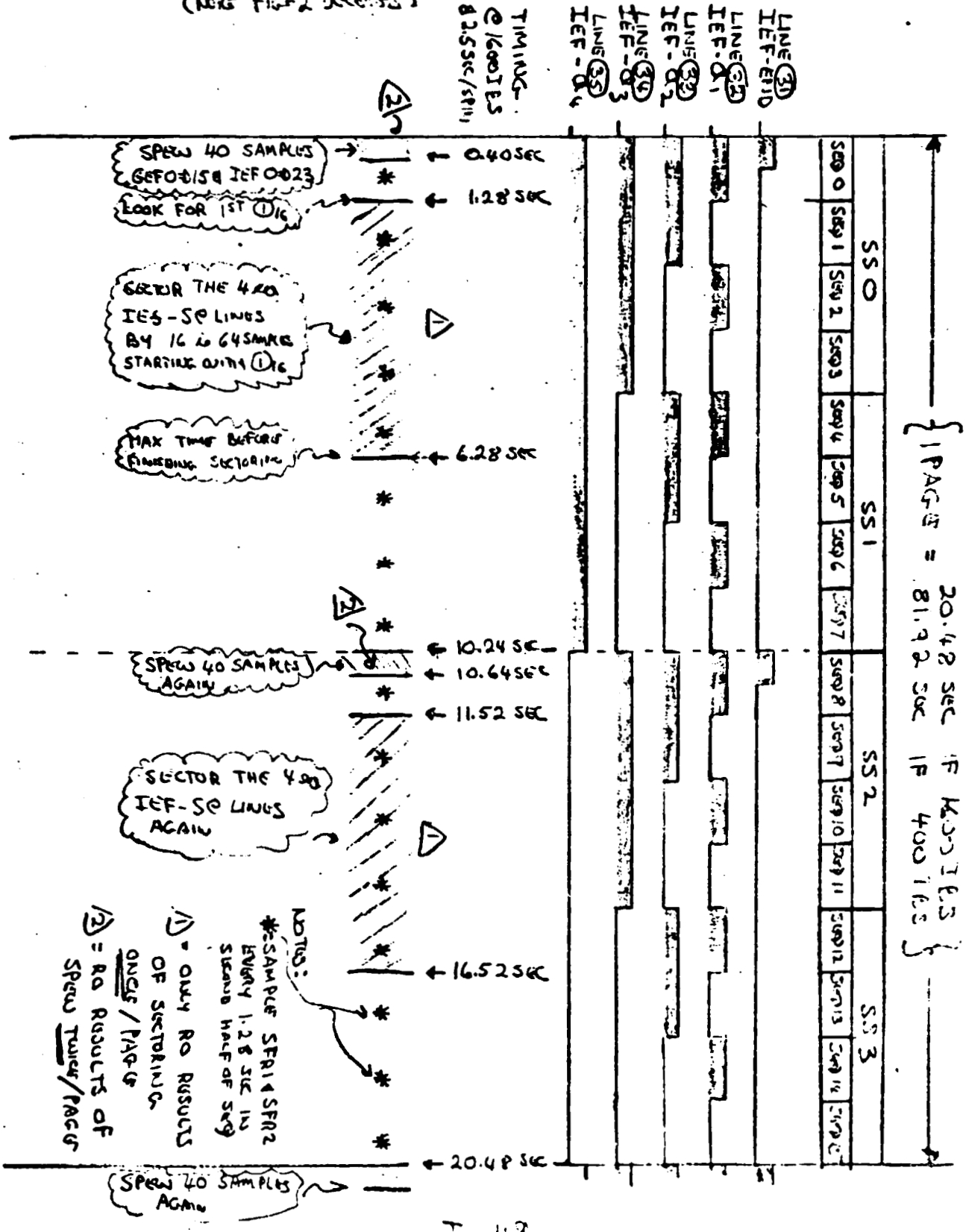
(39) ICF-C_{25} : 2.73 MIN PERIOD

(40) ICF-C_{28} : 21.8 MIN PERIOD

(41) ICF-C_{27} : 10.9 MIN PERIOD

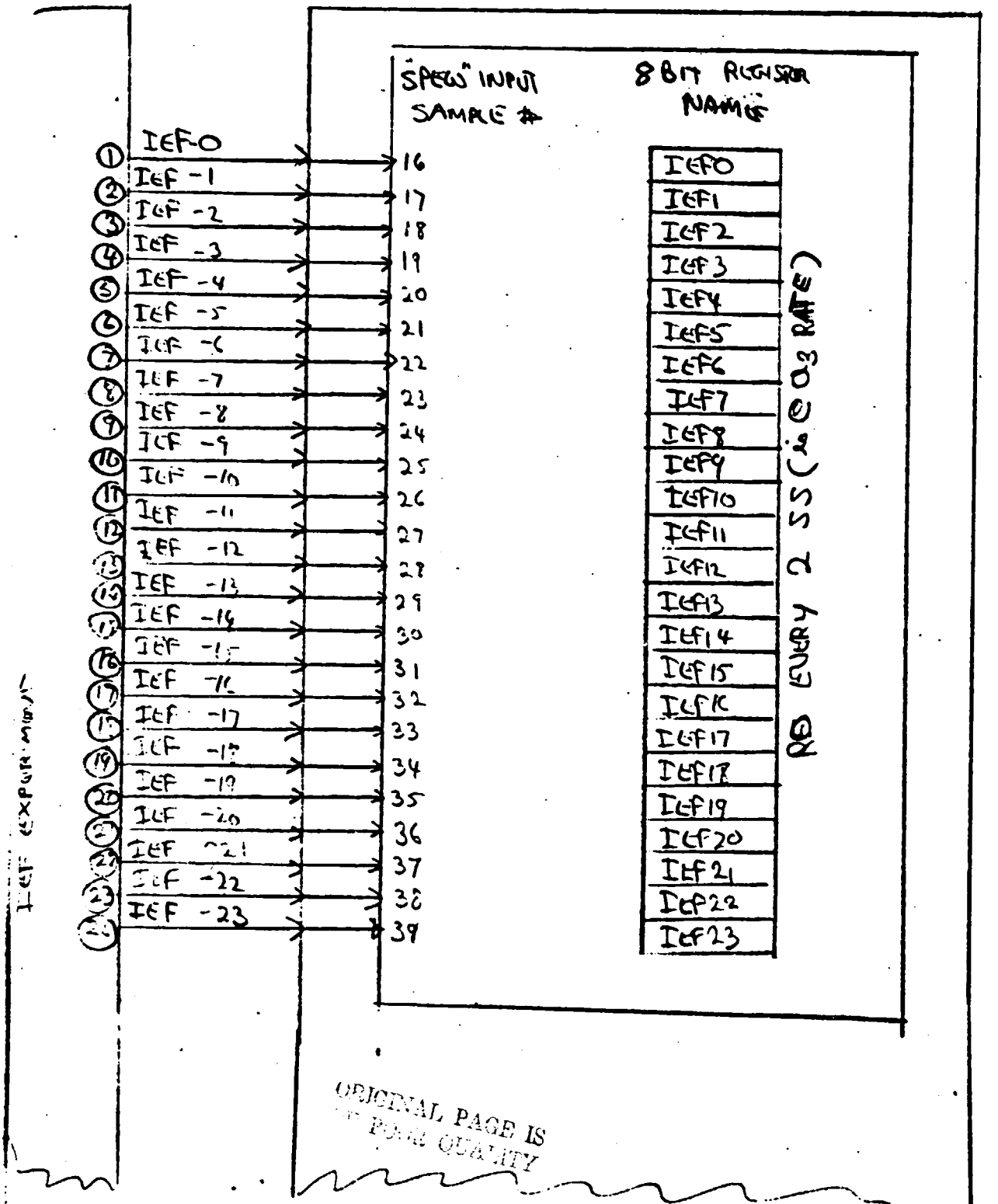
IMP H&J ENCODER
IEF # 6 OF 9

IEF - FIGURE # 1
(NOTE FIG #2 DELETED)



IMP H & J ENCODER
IEF # 7 of 9

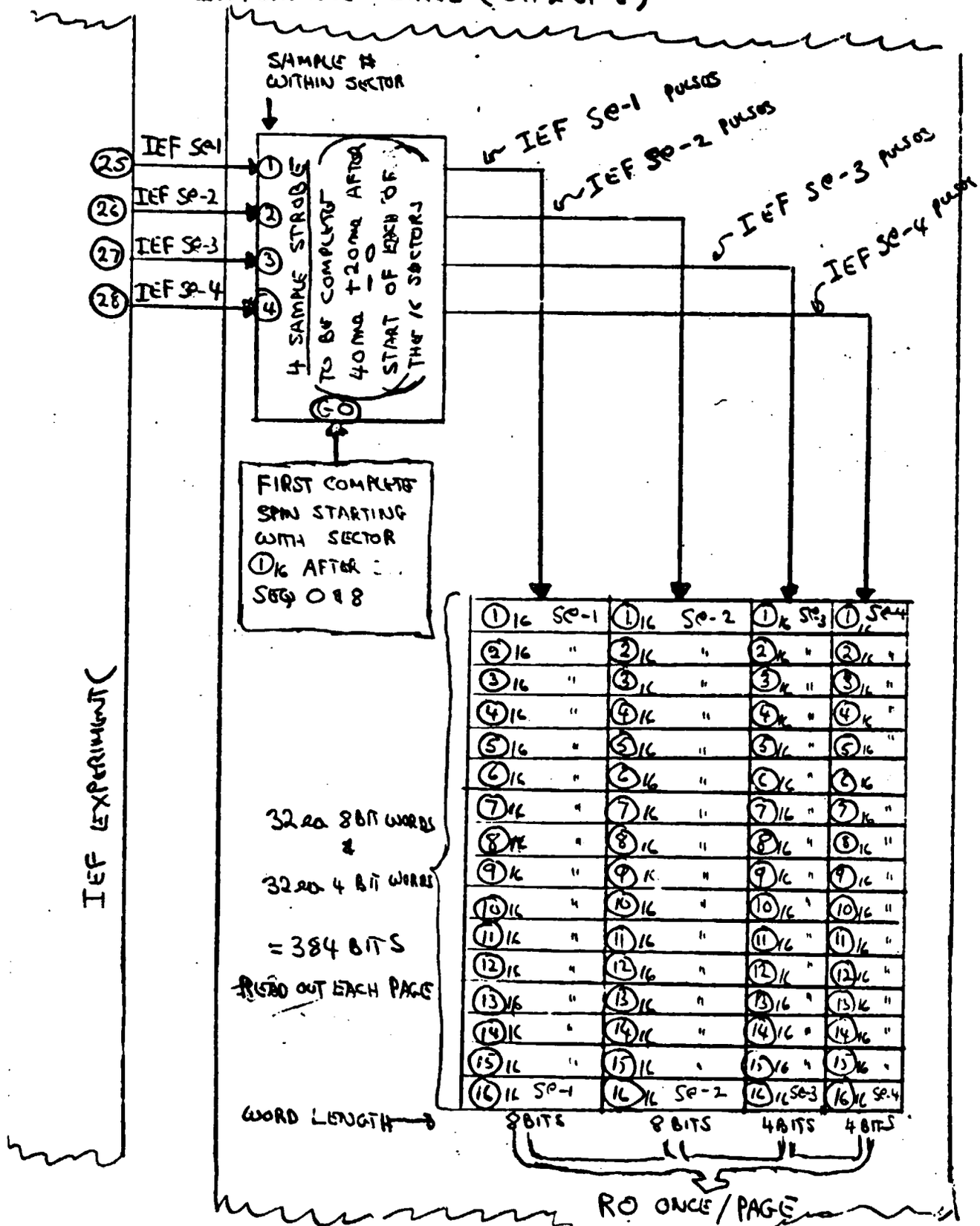
IEF - FIGURE # 3
INTERFACE WIRES (SH 1 OF 3)



IMP H & J ENCODER
IEF # 8 OF 9

IEF - FIGURE #4

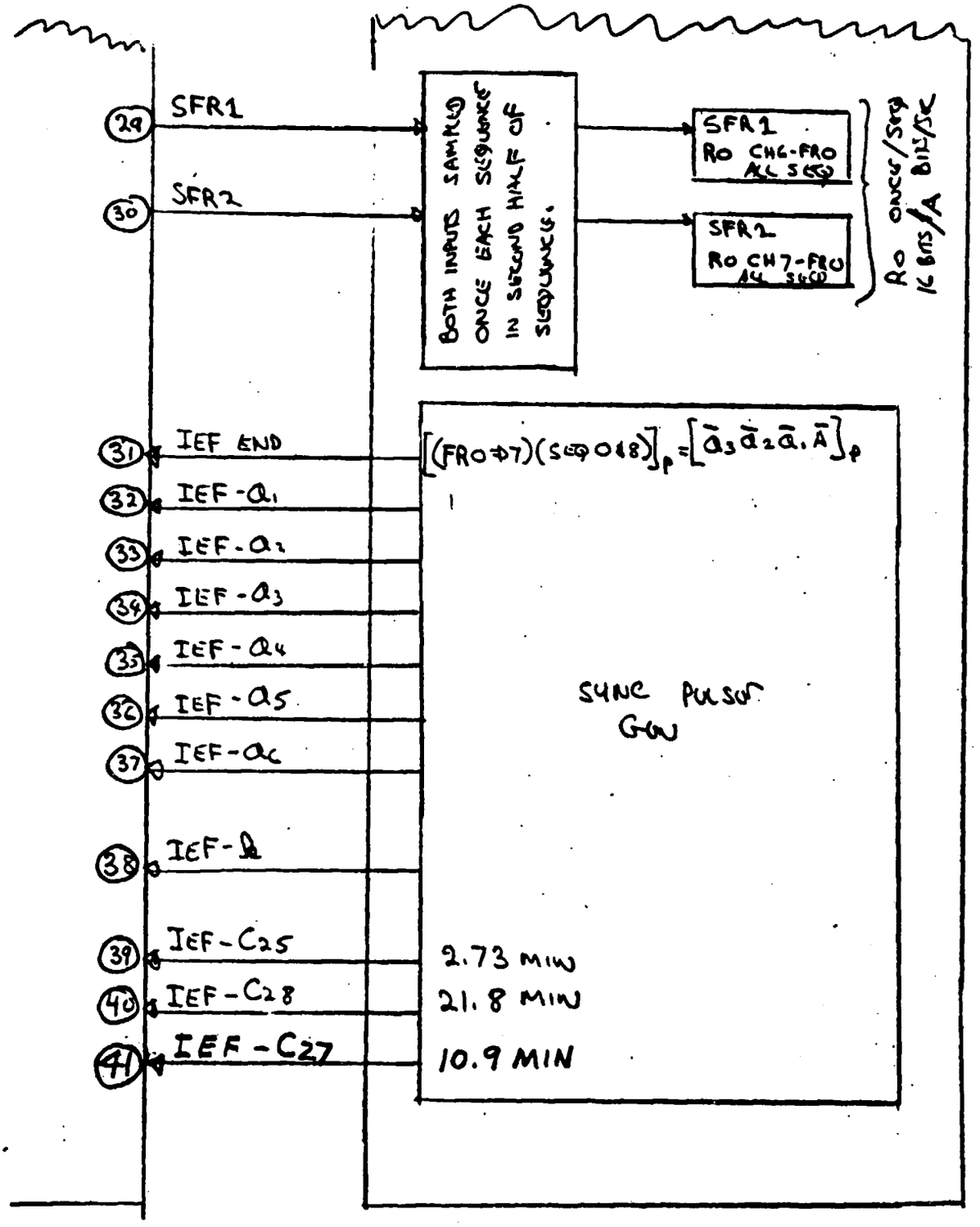
INTERFACE WIRES (SH 2 OF 3)



IMP H1J ENCODER
IEF # 9 of 9

IEF FIGURE # 5

INTERFACE WIRES (SH 3 OF 3)



3.2 Spectrum Analyzer IEF-0 through IEF-13

Data from the fourteen S. A. channels is read by the analog spewer. There are a total of 48 spew positions (0 through 47). The 48 spews takes ~ 480 m.s. Spew time is independent of Bit Rate. Each spew is 100_8 counts (10 ms) of clock line C_5) wide. Data readin during each spew takes 40 cts (5 ms) centered in the spew. (See GSFC #GE 1281-509 IMP-J Misc. Slab Analog Readin Wave Forms). Spewing occurs twice per page, at the start of SEQ0 and SEQ8. Average values are read in during SEQ0, Peak values read in during SEQ8. Read out occurs during following half page.

	Data Read In			Data Read Out			
Line	Spew Position	Seq	Delay from Start of Half Page	Page*	Seq	Frame	Channel
IEF0 (A)	16	0	2040_8	+0	13	0	8
(P)	16	8		+1	5	0	8
IEF1 (A)	17	0	2140_8	+0	13	0	9
(P)	17	8		+1	5	0	9
IEF2 (A)	18	0	2240_8	+0	13	0	10
(P)	18	8		+1	5	0	10
IEF3 (A)	19	0	2340_8	+0	13	0	11
(P)	19	8		+1	5	0	11
IEF4 (A)	20	0	2440_8	+0	13	0	12
(P)	20	8		+1	5	0	12
IEF5 (A)	21	0	2540_8	+0	13	0	13
(P)	21	8		+1	5	0	13
IEF6 (A)	22	0	2640_8	+0	13	0	14
(P)	22	8		+1	5	0	14
IEF7 (A)	23	0	2740_8	+0	13	0	15
(P)	23	8		+1	5	0	15

IEF8 (A)	24	0	3040_8	+0	14	0	8
(P)	24	8		+1	6	0	8
IEF9 (A)	25	0	3140_8	+0	14	0	9
(P)	25	8		+1	6	0	9
IEF10 (A)	26	0	3240_8	+0	14	0	10
(P)	26	8		+1	6	0	10
IEF11 (A)	27	0	3340_8	+0	14	0	11
(P)	27	8		+1	6	0	11
IEF12 (A)	28	0	3440_8	+0	14	0	12
(P)	28	8		+1	6	0	12
IEF13 (A)	29	0	3540_8	+0	14	0	13
(P)	29	8		+1	6	0	13

*Page of +0 indicates same page, -1 page before, +1 following page.

3.3 Low Frequency Waveform Analyzer SE-1, SE-2, SE-3, SE-4

These lines are read in under the Analog Sectoring Format. There are 16 sectors (1-16) per Spin. Read In occurs during the first integral spin starting after the end of Seq. 0 and Seq. 8. Sectoring is independent of Bit Rate, and there will be 2 sectoring operations per page. Since sectoring is "in phase" with clock line C_{11}, thus there may be up to a 100_8 count (10 ms) delay between $\overline{16\sim/SP}$ and when the samples are actually sampled. (Sampling "should" start on the high to low transition of line $\overline{16\sim/SP}$. Each sectoring channel is 100 cts (10 ms) wide. Sampling takes 40 cts. (5 ms) and is centered in this channel. The sector read in occurs approximately (not exactly because due to the phase difference between C_{11} and $\overline{16\sim/SP}$ and other time delays) every 22.5° starting at 0°. The high to low transition at $\overline{16\sim/SP}$ occurs exactly every 22.5° starting at 0°. Time delays from transition of $\overline{16\sim/SP}$

Line	Minimum	Maximum
Sel	40_8	140_8
Se2	140_8	240_8
Se3	240_8	340_8
Se4	340_8	440_8

3.4 Step Frequency Receiver IEF-14 through LEF-23

The ten SFR lines are sampled by analog spewer. Voltages are clamped during spewing (clamped by IEF-END). Read out occurs during following half page. (See S. A. for more complete description of spewer).

	Date Read In			Data Read Out			
Line	Spew Position	Seq	Delay from Start of Half Page	Page	Seq	Frame	Channel
IEF14	30	0	3640_8	0	14	0	14
		8		+1	6	0	14
IEF15	31	0	3740_8	0	14	0	15
		8		+1	6	0	15
IEF16	32	0	4040_8	0	15	0	8
		8		+1	7	0	8
IEF17	33	0	4140_8	0	15	0	9
		8		+1	7	0	9
IEF18	34	0	4240_8	0	15	0	10
		8		+1	7	0	10
IEF19	35	0	4340_8	0	15	0	11
		8		+1	7	0	11
IEF20	36	0	4440_8	0	15	0	12
		8		+1	7	0	12
IEF21	37	0	4540_8	0	15	0	13
		8		+1	7	0	13
IEF22	38	0	4640_8	0	15	0	14
		8		+1	7	0	14
IEF23	39	0	4740_8	0	15	0	15
		8		+1	7	0	15

Since the output voltages are clamped, the data sampled represents the value each line had at the start of the half page. (As if all ten lines were sampled at the same time with no delay, at the beginning of the half page.)

3.5 and 3.6 Switchable Passive Filter and Wideband SFR-1, SFR-2

Data from the 8 SPF and WB channels is read in under the ESAS format. This format is dependent upon data rate. Each channel is 40_8 counts wide in the 1600 BPS Mode and 200_8 counts wide in the 400 BPS Mode. In the 1600 BPS mode sampling occurs during the whole channel. In the 400 BPS mode sampling occurs only during the last quarter of the channel. Delays are given to the center of the channel in the 1600 BPS mode only. (To compute the delays in the 400 BPS mode multiply delays by 4 and add 60 cts.) The SPF channels are clocked through the 8 frequencies by clock lines a_1, a_2, a_3 (these clock lines are Bit Rate dependent; a_1's period is always 2 seq., a_2's period is 4 seq., a_3's period is 8 seq.) twice per page. The WB line is sampled (evenly spaced samples) 16 times per page. Frequency is changed by commands. Readout occurs during following sequence for both SPF and WB.

	Data Read In					Data Read Out		
SPF Freq	Seq	Frame	Channel	Delay	Page	Seq	Frame	Channel
5.6 kHz	0	9	5	$\{11260_8\}$	0	1	0	6
	8	9	5		0	9	0	6
10 kHz	1	9	5	$\{31260_8\}$	0	2	0	6
	9	9	5		0	10	0	6
16 kHz	2	9	5	$\{51260_8\}$	0	3	0	6
	10	9	5		0	11	0	6
22 kHz	3	9	5	$\{71260_8\}$	0	4	0	6
	11	9	5		0	12	0	6
31.1 kHz	4	9	5	$\{111260_8\}$	0	5	0	6
	12	9	5		0	13	0	6
56kHz	5	9	5	$\{131260_8\}$	0	6	0	6
	13	9	5		0	14	0	6
100 kHz	6	9	5	$\{151260_8\}$	0	7	0	6
	14	9	5		0	15	0	6
178 kHz	7	9	5	$\{171260_8\}$	0	8	0	6
	15	9	5		+1	0	0	6

		Data Read In				Data Read Out			
	WB Sample	Seq	Frame	Channel	Delay	Page	Seq	Frame	Channel
1/2 page	1	0	13	5	15260_8	0	1	0	7
	2	1	13	5	35260_8	0	9	0	7
	3	2	13	5	55260_8	0	2	0	7
	4	3	13	5	75260_8	0	10	0	7
	5	4	13	5	115260_8	0	3	0	7
	6	5	13	5	135260_8	0	11	0	7
	7	6	13	5	155260_8	0	4	0	7
	8	7	13	5	175260_8	0	12	0	7
1/2 page	9	8	13	5	15260_8	0	5	0	7
	10	9	13	5	35260_8	0	13	0	7
	11	10	13	5	55260_8	0	6	0	7
	12	11	13	5	75260_8	0	14	0	7
	13	12	13	5	115260_8	0	7	0	7
	14	13	13	5	135260_8	0	15	0	7
	15	14	13	5	155260_8	0	8	0	7
	16	15	13	5	175260_8	1	0	0	7

3.7 Digital Paramters

The digital parameters are sampled and transmitted without delay. Each parameter is sampled 4 times per page. The digital parameters are commuted by clock line a_3. During SS-0 and SS-2 B Gain and Cmds 1, 2 and 3 are read in, during SS-1 and SS-3 E Gain and Cmds 4, 5 and 6 are read in.

Line	SS	Function		Seq	Frame	Channel
DF2-7	0,2 1,3	CMD 1 CMD 4		1, 5, 9, 13	8	4
DF2-31	0,2 1,3	CMD 2 CMD 5		3, 7, 11, 15	8	4
DF2-32	0,2 1,3	CMD 3 CMD 6		3, 7, 11, 15	8	4
DF2-33	0,2 1,3	BGain EGain	Bit 0 (2)	3, 7, 11, 15	12	4
DF2-34	0,2 1,3	BGain EGain	Bit 1 (4)	3, 7, 11, 15	12	4
DF2-35	0,2 1,3	BGain EGain	Bit 2 (8)	3, 7, 11, 15	12	4
DF2-36	0,2 1,3	BGain EGain	Bit 3 (16)	3, 7, 11, 15	12	4

Note: Since the sampling of data occurs over most of the telemetry format and each command is sampled only once per half page it is almost impossible to determine when a command change occurs to a higher resolution than 1/2 page. It was decided that the command status of the WR receiver associated with a particular half page of data should indicate as nearly as possible the command status at the start of

that particular half page. Since 2 the 3 commands (4, 5, and 6) for the WB status are sampled in Seq. 7 and 15 the commands read in during the half page before best represented the WB status at the start of the particular 1/2 page. For uniformity the SFR status is also taken from the half page before. The SFR gain state sampled the half page before exactly represents the gain state the system is in when the data is sampled during the particular half page.

3.8 Analog Parameters

These lines are sampled under the ESAS format with a one sequence delay between read in and read out [Boom temperature (AP-47) is read in only during odd pages.]

		Read In				Read Out		
Line	Function	Seq	Frame	Channel	Page	Seq	Frame	Channel
AP-12	+6 voltage monitor	11	1	5	+0	14	5	5
AP-47	Boom temperature	12	0	4	+0	15	0	5

3.9 Optical Aspect System - Sun Time, Spin Period

Sun Time is the number of counts of clock line C_5 from the start of the page to the first sun pulse. Spin Period is the number of counts of C_5 accumulated over 1 spin.

There are slightly less than 8 spins per page.

Some use full calculations.

The amount the ST advances in 1 page is computed by

$ST_{ADV} = 10_8 \times SP - 400000.$

The number of degrees the spacecraft rotates in 1/2 page

$$\theta = \frac{200000_8}{SP} \times \underbrace{550_8}_{360_{10}}$$

The number of degrees the spacecraft has rotated from the start of the half page and when the data is sampled:

$$\theta = \frac{\text{Delay Cts}}{SP} \times 550_8$$

$$\text{Spin Period}_{sec} = \frac{SP_{10}}{6.464 \times 10^3}$$

Errcrs in the Optical Aspect System:

Several error modes have been detected in the optical aspect system, but as of yet no error in ST has been detected when the SP is correct.

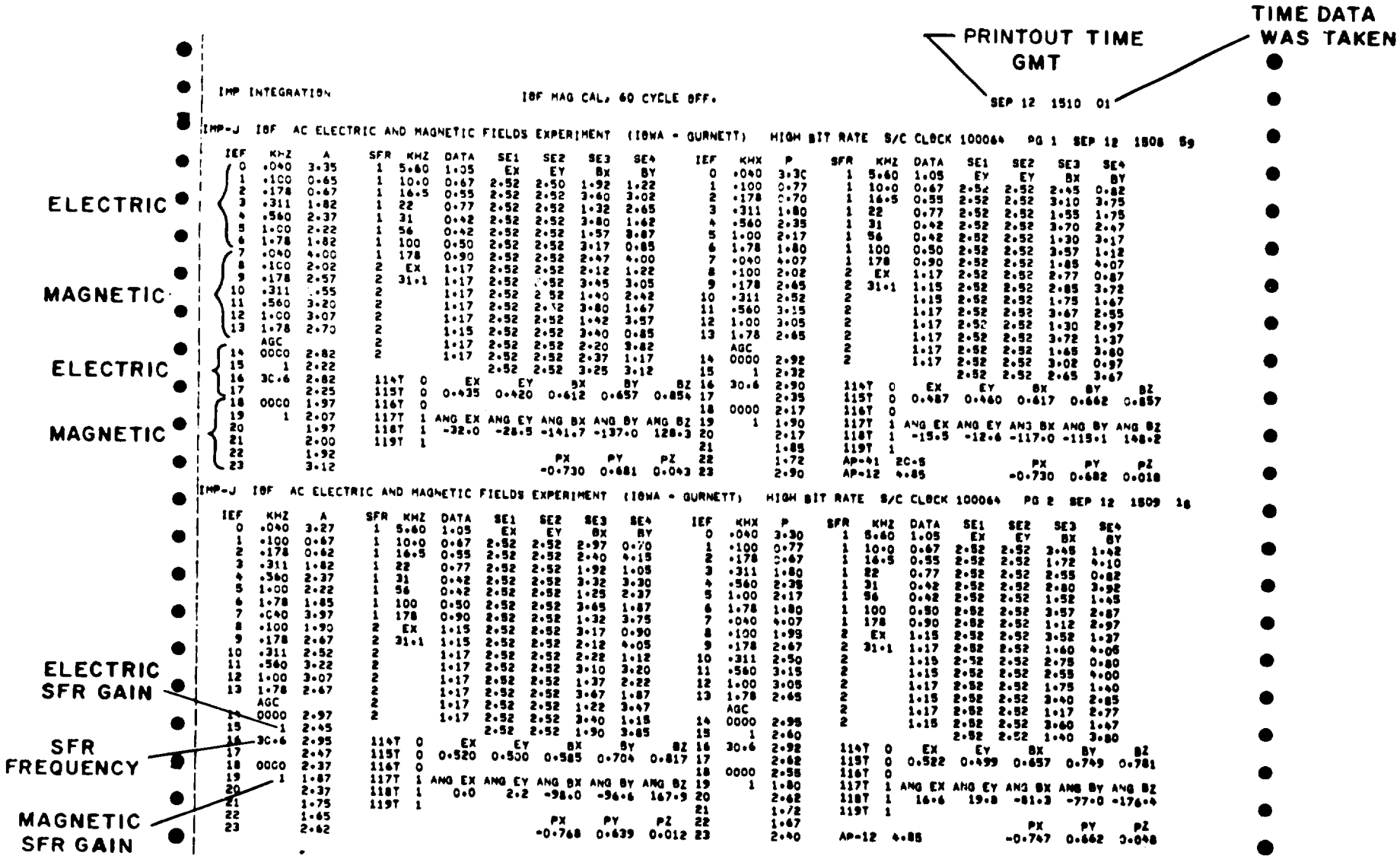
1) Spin period error but correct ST. Spin period is often in error by $\sim \pm 103_8$ counts. This is thought to be caused by an internal reflection.
2) Both SP and ST in error
   a. The ST is $\sim \pm 103_8$ counts in error when the SP is $\pm 103_8$ counts in error.
   b. The ST is equal to the correct ST plus the Spin Period, the SP is off by the $\pm 103_8$ counts.
   c. The ST is equal to the correct ST plus the Spin Period and $\sim \pm 103_8$ counts when the SP is off by $\sim \pm 103_8$ counts.

When errors do occur in the optical aspect system due to the internal reflections, the sectoring operation may not start at the correct time and may not have the correct sample spacing. Unfortunately only optical aspect data from 1 of 8 spins is obtainable, thus there is no way to determine if the sectoring is being performed correctly.

4.0 QUICK LOOK PRINTOUT FORMAT

4.1 General Description

The general layout of the quick look printout is shown in Figure 4.1, which is a sample quick look printout.



IMP INTEGRATION I8F MAG CAL, 60 CYCLE OFF. SEP 12 1510 01

IMP-J I8F AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (I8WA - GURNETT) HIGH BIT RATE S/C CLOCK 100064 PG 1 SEP 12 1508 59

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.35	1	5.60	1.05	EX	EY	BX	BY
1	.100	0.65	1	10.0	0.67	2.52	2.50	1.92	1.22
2	.178	0.47	1	16.5	0.55	2.52	2.52	3.40	3.02
3	.311	1.82	1	22	0.77	2.52	2.52	1.32	2.65
4	.560	2.37	1	31	0.42	2.52	2.52	3.80	1.62
5	1.00	2.22	1	56	0.42	2.52	2.52	1.57	3.87
6	1.78	1.82	1	100	0.50	2.52	2.52	3.17	0.85
7	.040	4.00	1	178	0.90	2.52	2.52	2.47	4.00
8	.100	2.02	2	EX	1.17	2.52	2.52	2.12	1.22
9	.178	2.57	2	31.1	1.17	2.52	2.52	3.45	3.05
10	.311	.455	2		1.17	2.52	2.52	1.40	2.42
11	.560	3.20	2		1.17	2.52	2.52	3.80	1.67
12	1.00	3.07	2		1.17	2.52	2.52	1.42	3.57
13	1.78	2.70	2		1.15	2.52	2.52	3.40	0.85
	AGC		2		1.17	2.52	2.52	2.20	3.82
14	0000	2.82	2		1.17	2.52	2.52	2.37	1.17
15	1	2.22				2.52	2.52	3.25	3.12
16	30.6	2.82	114T	0		EX	EY	BX	BY
17		2.25	115T	0	0.435	0.420	0.612	0.657	0.854
18	0000	1.97	116T	0					
19	1	2.07	117T	1	ANG EX	ANG EY	ANG BX	ANG BY	ANG BZ
20		1.97	118T	1	-32.0	-28.5	-141.7	-137.0	128.3
21		2.00	119T	1					
22		1.92					PX	PY	PZ
23		3.12					-0.730	0.681	0.043

IEF	KHX	P	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.3C	1	5.60	1.05	EX	EY	BX	BY
1	.100	0.77	1	10.0	0.67	2.52	2.52	2.45	0.82
2	.178	0.70	1	16.5	0.55	2.52	2.52	3.10	3.75
3	.311	1.80	1	22	0.77	2.52	2.52	1.55	1.75
4	.560	2.35	1	31	0.42	2.52	2.52	3.70	2.47
5	1.00	2.17	1	96	0.42	2.52	2.52	1.30	3.17
6	1.78	1.80	1	100	0.50	2.52	2.52	3.57	1.12
7	.040	4.07	1	178	0.90	2.52	2.52	1.85	4.07
8	.100	2.02	2	EX	1.17	2.52	2.52	2.77	0.87
9	.178	2.65	2	31.1	1.15	2.52	2.52	2.85	3.72
10	.311	2.52	2		1.15	2.52	2.52	1.75	1.67
11	.560	3.15	2		1.17	2.52	2.52	3.67	2.55
12	1.00	3.05	2		1.17	2.52	2.52	1.30	2.97
13	1.78	2.65	2		1.17	2.52	2.52	3.72	1.37
	AGC		2		1.17	2.52	2.52	1.65	3.80
14	0000	2.92	2		1.17	2.52	2.52	3.02	0.97
15	1	2.32				2.52	2.52	2.65	3.67
16	30.6	2.90	114T	0		EX	EY	BX	BY
17		2.35	115T	0	0.487	0.460	0.617	0.662	0.857
18	0000	2.17	116T	0					
19	1	1.90	117T	1	ANG EX	ANG EY	ANG BX	ANG BY	ANG BZ
20		2.17	118T	1	-15.5	-12.6	-117.0	-115.1	148.2
21		1.85	119T	1					
22		1.72	AP-41	2C.5			PX	PY	PZ
23		2.90	AP-12	4.85			-0.730	0.682	0.018

IMP-J I8F AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (I8WA - GURNETT) HIGH BIT RATE S/C CLOCK 100064 PG 2 SEP 12 1509 18

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.27	1	5.60	1.05	EX	EY	BX	BY
1	.100	0.67	1	10.0	0.67	2.52	2.52	2.97	0.70
2	.178	0.62	1	16.5	0.55	2.52	2.52	2.40	4.15
3	.311	1.82	1	22	0.77	2.52	2.52	1.92	1.05
4	.560	2.37	1	31	0.42	2.52	2.52	3.32	3.30
5	1.00	2.22	1	56	0.42	2.52	2.52	1.25	2.37
6	1.78	1.85	1	100	0.50	2.52	2.52	3.65	1.87
7	.040	3.97	1	178	0.90	2.52	2.52	1.32	3.75
8	.100	1.99	2	EX	1.15	2.52	2.52	3.17	0.90
9	.178	2.67	2	31.1	1.15	2.52	2.52	2.12	4.05
10	.311	2.52	2		1.17	2.52	2.52	2.22	1.12
11	.560	3.22	2		1.17	2.52	2.52	3.10	3.20
12	1.00	3.07	2		1.17	2.52	2.52	1.37	2.22
13	1.78	2.67	2		1.17	2.52	2.52	3.67	1.87
	AGC		2		1.17	2.52	2.52	1.22	3.47
14	0000	2.97	2		1.17	2.52	2.52	3.40	1.15
15	1	2.45				2.52	2.52	1.90	3.85
16	30.6	2.95	114T	0		EX	EY	BX	BY
17		2.47	115T	0	0.520	0.500	0.685	0.704	0.817
18	0000	2.37	116T	0					
19	1	1.87	117T	1	ANG EX	ANG EY	ANG BX	ANG BY	ANG BZ
20		2.37	118T	1	0.0	2.2	-98.0	-96.6	167.9
21		1.75	119T	1					
22		1.65					PX	PY	PZ
23		2.62					-0.768	0.639	0.012

IEF	KHX	P	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.30	1	5.60	1.05	EX	EY	BX	BY
1	.100	0.77	1	10.0	0.67	2.52	2.52	3.45	1.42
2	.178	0.67	1	16.5	0.55	2.52	2.52	1.72	4.10
3	.311	1.80	1	22	0.77	2.52	2.52	2.55	0.82
4	.560	2.35	1	31	0.42	2.52	2.52	2.80	3.92
5	1.00	2.17	1	96	0.42	2.52	2.52	1.52	1.45
6	1.78	1.80	1	100	0.50	2.52	2.52	3.57	2.87
7	.040	4.07	1	178	0.90	2.52	2.52	1.12	2.97
8	.100	1.99	2	EX	1.15	2.52	2.52	3.52	1.37
9	.178	2.67	2	31.1	1.17	2.52	2.52	1.40	4.06
10	.311	2.50	2		1.15	2.52	2.52	2.78	0.80
11	.560	3.15	2		1.15	2.52	2.52	2.55	4.00
12	1.00	3.05	2		1.17	2.52	2.52	1.75	1.40
13	1.78	2.65	2		1.15	2.52	2.52	3.40	2.85
	AGC		2		1.17	2.52	2.52	1.17	2.77
14	0000	2.95	2		1.15	2.52	2.52	3.60	1.47
15	1	2.40				2.52	2.52	1.40	3.80
16	30.6	2.92	114T	0		EX	EY	BX	BY
17		2.62	115T	0	0.522	0.499	0.657	0.749	0.781
18	0000	2.55	116T	0					
19	1	1.80	117T	1	ANG EX	ANG EY	ANG BX	ANG BY	ANG BZ
20		2.62	118T	1	16.6	19.8	-81.3	-77.0	-176.4
21		1.72	119T	1					
22		1.67					PX	PY	PZ
23		2.40	AP-12	4.85			-0.747	0.662	0.048

Figure 4.1

4.2 SFR Symbol Definitions

I. Additions

A. For the additional computations let

$E_{cx} = (IEF\text{-}14) - x_{14}$
$E_{sx} = (IEF\text{-}15) - x_{15}$
$E_{cy} = (IEF\text{-}16) - x_{16}$
$E_{sy} = (IEF\text{-}17) - x_{17}$
$B_{cx} = (IEF\text{-}18) - x_{18}$
$B_{sx} = (IEF\text{-}19) - x_{19}$
$B_{cy} = (IEF\text{-}20) - x_{20}$
$B_{sy} = (IEF\text{-}21) - x_{21}$
$B_{cz} = (IEF\text{-}22) - x_{22}$
$B_{sz} = (IEF\text{-}23) - x_{23}$

The x_{14} through x_{23} are variables which will be provided by IOF engineers prior to a computer run, and may be updated during a run.

B. Computations

1. Polarization Vector

$Px = (Bcy\ Bsz - Bcz\ Bsy)$
$Py = (Bcz\ Bsx - Bcx\ Bsz)$
$Pz = (Bcx\ Bsy - Bcy\ Bsx)$

$$\bar{P}x = \frac{Px}{(Px^2 + Py^2 + Pz^2)^{1/2}}$$

$$\bar{P}y = \frac{Py}{(Px^2 + Py^2 + Pz^2)^{1/2}}$$

$$\bar{P}z = \frac{Pz}{(Px^2 + Py^2 + Pz^2)^{1/2}}$$

2. Phase Angles and Magnitude

$$Ex = [(Esx)^2 + (Ecx)^2]^{1/2}$$
$$Ey = [(Esy)^2 + (Ecy)^2]^{1/2}$$
$$Bx = [(Bsx)^2 + (Bcx)^2]^{1/2}$$
$$By = [(Bsy)^2 + (Bcy)^2]^{1/2}$$
$$Bz = [(Bsz)^2 + (Bcz)^2]^{1/2}$$

$$\theta_{Ex} = \text{Tan}^{-1} \left(\frac{Esx}{Ecx}\right)$$
$$\theta_{Ey} = \text{Tan}^{-1} \left(\frac{Esy}{Ecy}\right)$$
$$\theta_{Bx} = \text{Tan}^{-1} \left(\frac{Bsx}{Bcx}\right)$$
$$\theta_{By} = \text{Tan}^{-1} \left(\frac{Bsy}{Bcy}\right)$$
$$\theta_{Bz} = \text{Tan}^{-1} \left(\frac{Bsz}{Bcz}\right)$$

θ must be in degrees and cover a full 360° (the sign of the numerator and the denominator must be used to determine which quadrant θ is in)

C. Format: Should be printed everyother sequence and may be placed in any convenient location on computer printout and monitor.

Ex	Ey	Bx	By	Bz
data	data	data	data	data
θ_{Ex}	θ_{Ey}	θ_{Bx}	θ_{By}	θ_{Bz}
data	data	data	data	data
$\bar{P}x$	$\bar{P}y$	$\bar{P}z$		
data	data	data		

II. Modifications

A. Decode AGC code in place of the four binary digits display numerical gain.

The numerical gain of the AGC can be computed by the formula

GAIN = A x B x C x D

where A = 1 if the first binary digit from left is equal to Logic 0, A = 2 if digit is equal to Logic 1.

B = 1 if second binary digit from left is equal to Logic 0, B = 4 if digit is equal to Logic 1.

C = 1 if third binary digit from left is equal to Logic 0, C = 8 if digit is equal to Logic 1.

D = 1 if last binary digit is equal to Logic 0, D = 16 if digit is equal to Logic 1.

Thus an AGC value of 1010 - 2 x 1 x 8 x 1 = 16

B. Decode command status for wideband receiver channel and frequency

114T	117T	118T	119T		Channel	Freq.
*	0	0	0	→	Ex	0-1 kHz
*	1	0	0		Ey	0-1 kHz
*	0	1	0		Bx	0-1 kHz
*	1	1	0		By	0-1 kHz
1	0	0	1		Ey	2 MHz
0	0	0	1		Ex	2 MHz
1	1	0	1		Ey	500 kHz
0	1	0	1		Ex	500 kHz
1	0	1	1		Ey	125 kHz
0	0	1	1		Ex	125 kHz
1	1	1	1		Ey	31.1 kHz
0	1	1	1		Ex	31.1 kHz

*INDEPENDENT OF 114T

The decoded in formation should be placed in the position indicated on the computer format sheet.

C. Decode Command Status for Step Frequency Receiver Frequency

114T	115T	116T	Frequency
0	0	0	30.6 Hz
1	0	0	61.5 Hz
0	1	0	124.0 Hz
1	1	0	252.0 Hz
0	0	1	520.8 Hz
1	0	1	1116.0 Hz
0	1	1	1802.8 Hz
1	1	1	2604.1 Hz

The decoded information should be placed in the position indicated on the computer format sheet.

Computer Format for 1/2 Page of Data
(First half of page identifical to second half except for peak or average reading)

IEF	KHZ	P(or A)	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	Data	1	5.6	Data	EX	EY	BX	BY
1	.100	data	1	10.0	data	data	data	data	data
2	1.78	data	1	16.5	data	data	data	data	data
3	.311	data	1	22	data	data	data	data	data
4	.560	data	1	31	data	data	data	data	data
5	1.00	data	1	56	data	data	data	data	data
6	1.78	data	1	100	data	data	data	data	data
7	.040	data	1	178	data	data	data	data	data
8	.100	data	2	E_y [3]	data	data	data	data	data
9	.178	data	2	500	data	data	data	data	data
10	.311	data	2		data	data	data	data	data
11	.560	data	2		data	data	data	data	data
12	1.00	data	2		data	data	data	data	data
13	1.78	data	2		data	data	data	data	data
	AGC		2		data	data	data	data	data
14	16 [1]	data	2		data	data	data	data	data
15	2.604 [2]	data				data	data	data	data
16		data	114T	0					
17		data	115T	1					
18	256 [1]	data	116T	0					
19		data	117T	1					
20		data	118T	0					
21		data	119T	1					
22		data	AP-41	20°					
23		data	AP-12	2.56					

[1] Decoded AGC

[2] Step Frequency Receiver Decoded Commands

[3] Wideband Receiver Decoded Commands

5.0 CALIBRATIONS

5.1 Electric Antenna

The lengths of the electric antenna elements was measured before launch at GSFC. The measured length is from the side of the spacecraft to the tip of the antenna. To obtain the tip-to-tip length, the diameter of the spacecraft (4.45 ft.) must be added to the element length. The measured lengths are summarized below.

Antenna	Element Length	Tip-to-Tip Length
+Y	197.0 ft.	399.45 ft.
-Y	198.0 ft.	
+X	195.5 ft.	395.45 ft.
-X	195.5 ft.	

The conducting outer tip of each element was carefully adjusted to a length of 50 ft. 3 in. for each element.

The base capacity of the electric antenna mechanisms (not counting preamps and cables) was measured under both extended and retracted conditions by EMR (Mr. Kenneth Thom). The extended measurements were made with the element coiled on top of a wooden table serveral feet from the mechanism. The extended capacity measurements, although they do include some contribution due to the element, are within a few pf of the value (26 pf) obtained on an engineering unit

in which the element was actually cut off after extension so as to determine the true base capacity. The error in the extended base capacity measurements due to the extended portion of the element is therefore believed to be not more than 5 pf.

Antenna Mechanism	Base Capacity* Retracted	Extended
+Y	66 to 68 pf	
-Y	66 to 70 pf	30 pf
+X	65 to 68 pf	30 pf
-X	60 pf	31 pf

*Frequency = 1 kHz

The base capacities of the electric antennas (in this case with preamps) were also measured in the retracted position by driving the antenna with a calibrated reference capacity and measuring the attenuation.

The results of these measurements are summarized in Table 5.1.1. The direct input measurements were made by grounding the opposite antenna element and driving the antenna directly with no attenuation between the voltage generator and the antenna. The C_{Ref} measurements were made with the opposite antenna element still grounded, but with a reference capacity (C_{Ref} = 8.2 pf) in series between the voltage generator and the antenna. All measurements were made at a frequency of 1 kHz.

Table 5.1.1

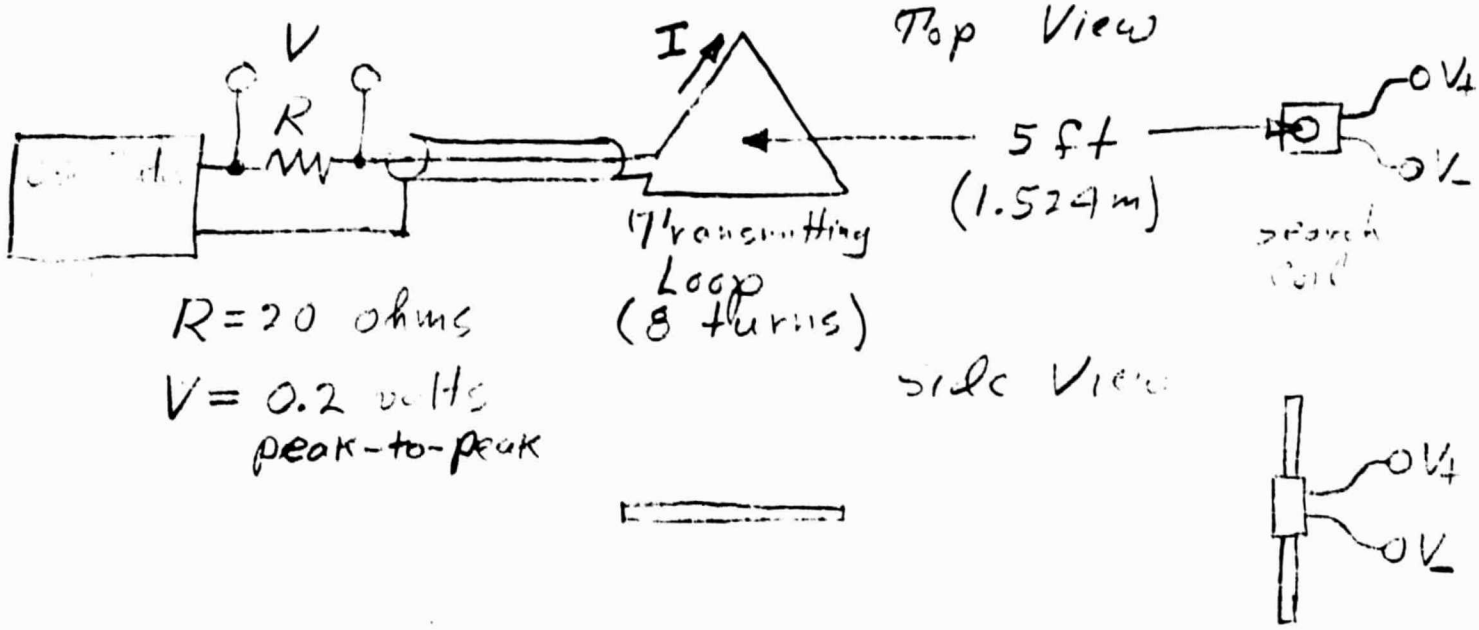
Base Capacity of Electric Antennas

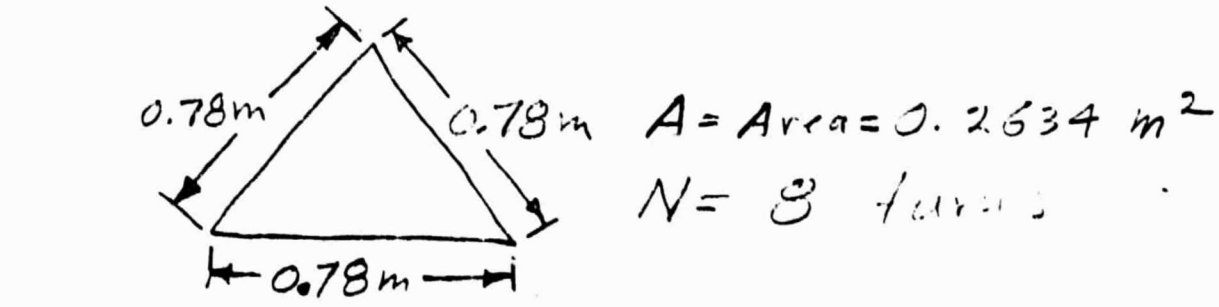
	Antenna			
	+X	-X	+Y	-Y
Facet	14	6	2	10
Compressor Output (Direct)	4.49 volts	4.49 volts	4.49 volts	4.49 volts
Compressor Output (C_{Ref})	3.22 volts	3.17 volts	3.19 volts	3.18 volts
Equivalent input difference between Direct and C_{Ref}*	24.0 db	25.4 db	24.8 db	25.1 db
R = ratio (Direct/C_{Ref})	15.85	18.62	17.38	17.99
C_B (retracted) = C_{Ref} (R-1)	121 pf	144 pf	134 pf	139 pf
C_B (extended) = C_B (retracted) - 35	86 pf	109 pf	99 pf	104 pf

*From spectrum analyzer calibration data for channel IEF-0.

5.2 Search Coil Calibration

The absolute sensitivity and frequency response of the IMP-J search coils were determined at the NLRO field test site using a transmitting loop with a known A. C. current at a known distance from the search coil. The detailed configuration of the transmitting loop and search coil are shown below.





All data were taken with V = 0.2 volts peak-to-peak across the resistor R = 20 ohm. The current through the loop was therefore I = 0.01 amps (peak-to-peak). The B field at the search coil is therefore

$$B = \frac{\mu_o}{4\pi} \frac{M}{r^3} \quad ; \quad M = NIA$$

$$M = (8)(0.01)(0.2634) \text{ amps m}^2 = 0.0211 \text{ amps m}^2$$

$$\frac{\mu_o}{4\pi} = 10^{-7} \quad ; r = 1.524 \text{ m}$$

$$B = 10^{-7} \frac{0.0211}{(1.524)3} = 5.95 \times 10^{-10} \text{ Weber/m}^2$$

$$B = 0.595 \text{ gamma (peak-to-peak)}$$

The differential voltage out of the search coil preamplifiers $\Delta V_{out} = V_+ - V_-$ was then measured as a function of frequency. The results of these measurements are summarized below

Frequency f	X IOF 2-10(A)		Y IOF 2-11(B)		Z IOF 2-12		SPARE IOF 2-13(C)	
	ΔV_{out} Volts*	G	ΔV_{out} Volts*	G	ΔV_{out} Volts*	G	ΔV_{out} Volts*	G
200 Hz	0.02	1.00	0.02	1.00	0.02	1.00	0.02	1.00
300 Hz	0.03	1.00	0.03	1.00	0.03	1.00	0.03	1.00
500 Hz	0.05	1.00	0.05	1.00	0.05	1.00	0.05	1.00
1.00 kHz	0.10	1.00	0.10	1.00	0.10	1.00	0.10	1.00
1.50 kHz	0.16	1.07	0.16	10.7	0.16	1.07	0.16	1.07
2.00 kHz	0.21	1.05	0.21	1.05	0.21	1.05	0.21	1.05
2.50 kHz	0.25	1.00	0.25	1.00	0.25	1.00	0.25	1.00
2.75 kHz	0.25	0.91	0.25	0.91	0.24	0.87	0.23	0.84

(cont'd.)

Frequency f	X IOF 2-10(A) ΔV_{out} Volts*	g	Y IOF 2-11(B) ΔV_{out} Volts*	g	Z IOF 2-12 ΔV_{out} Volts*	g	SPARE IOF 2-13(C) ΔV_{out} Volts*	g
3.00 kHz	0.24	0.80	0.24	0.80	0.23	0.77	0.22	0.73
3.50 kHz	0.20	0.57	0.20	0.57	0.19	0.54	0.18	0.51
4.00 kHz	0.17	0.43	0.16	0.40	0.15	0.37	0.16	0.40

*Peak-to-peak voltage

All output voltages are measured as peak-to-peak volts. The gain factor, g, normalized to a frequency of 1 kHz is defined as

$$g(f) = \frac{\Delta V_{out}}{f} \left(\frac{f}{\Delta V_{out}} \right)_{f=1\ kHz}$$

$$g(f) = \frac{\Delta V_{out}}{f} \times 10^{4} \quad .$$

The gain factors are plotted in Figures 5.2.1, through 5.2.4 for the four sensors. The normalized preamplifier and coil sensitivity, K', at a frequency of 1 kHz is essentially identical for all four search coils with a value of

$$K' = \left(\frac{\Delta V_{out}}{Bf} \right)_{f=1\ kHz}$$

$$K' = \frac{(0.1)}{(0.595)(10^{3})} = 167.9 \ \frac{\mu\ volt}{gamma\ Hz}$$

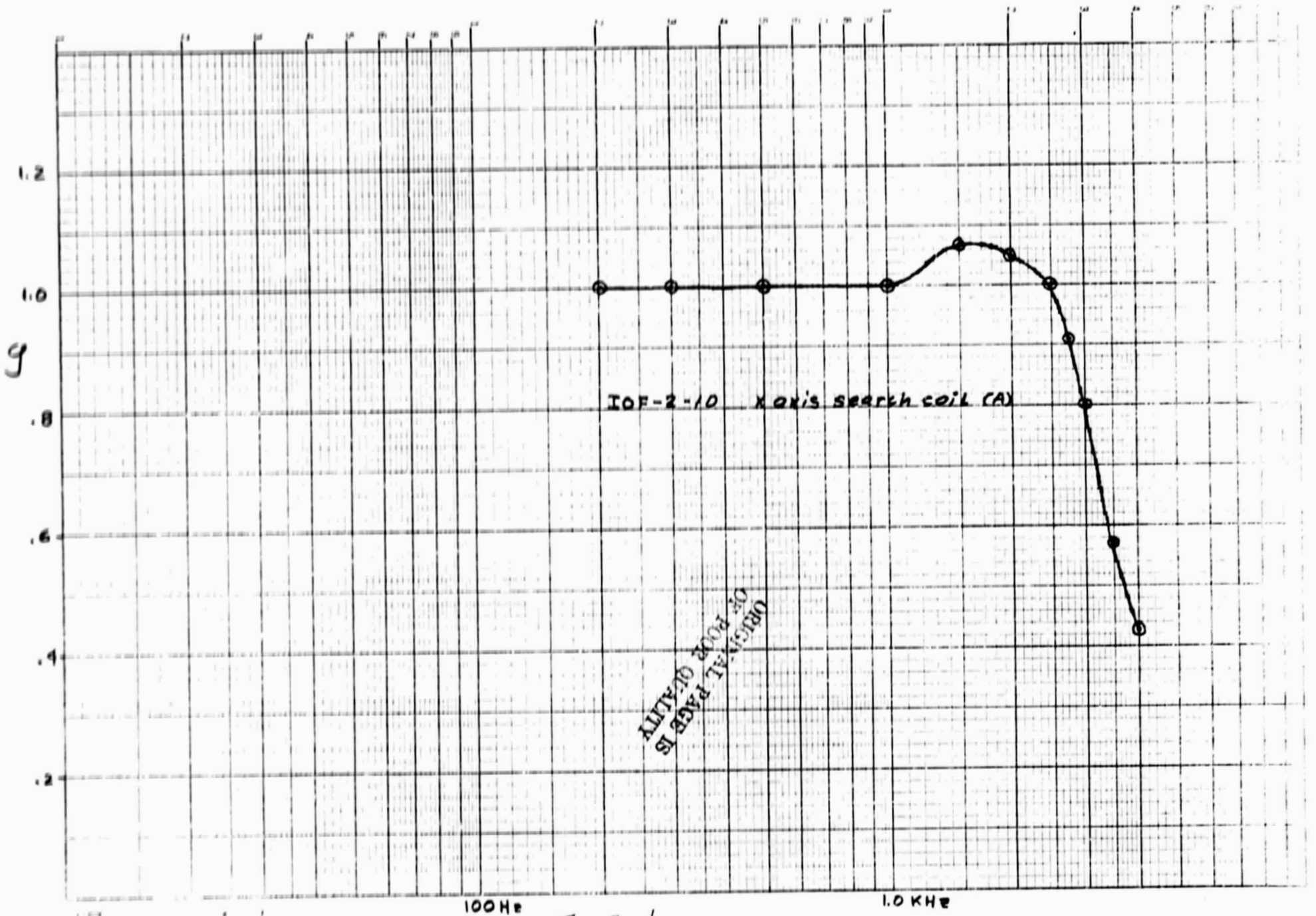

1.2
1.0
.8
.6
.4
.2
G
IOF-2-10 X axis search coil (A)
100Hz
1.0 KHz
ORIGINAL PAGE IS
OF POOR QUALITY

Figure 5-2.1

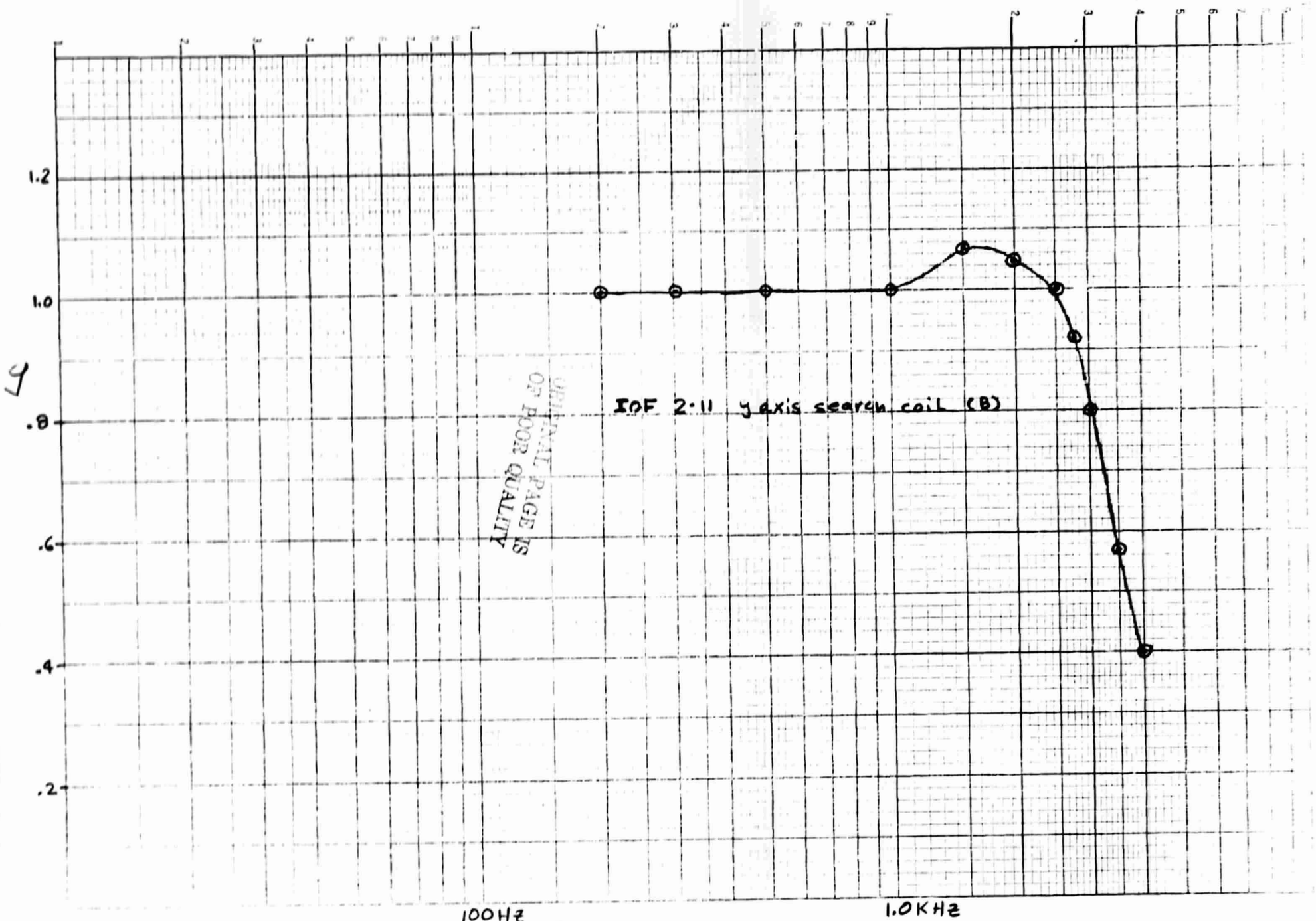


Figure 5-2-2

SEMI LOGARITHMIC 46 5490

KEUFFEL & ESSER CO.

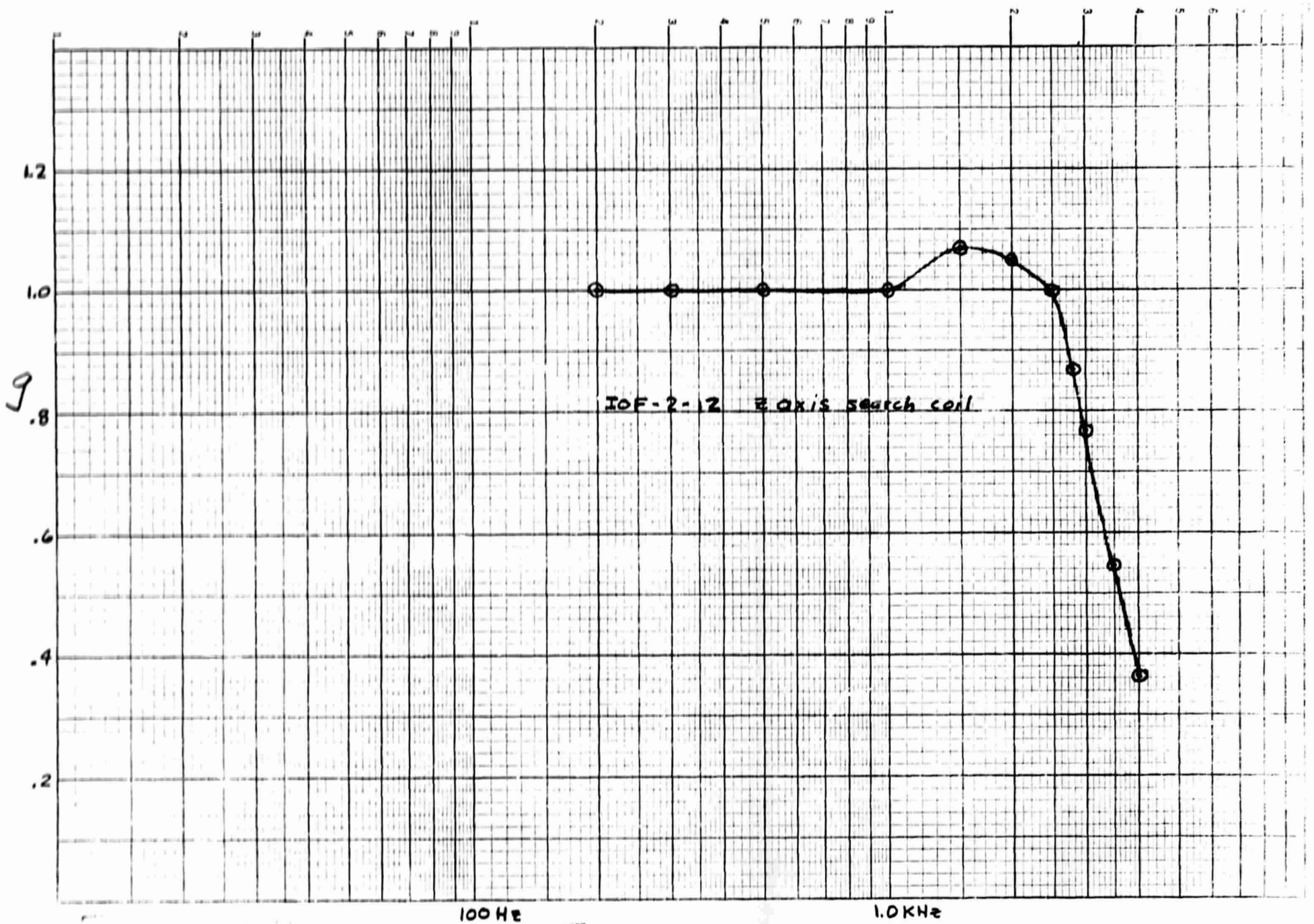


Figure 5-2.3

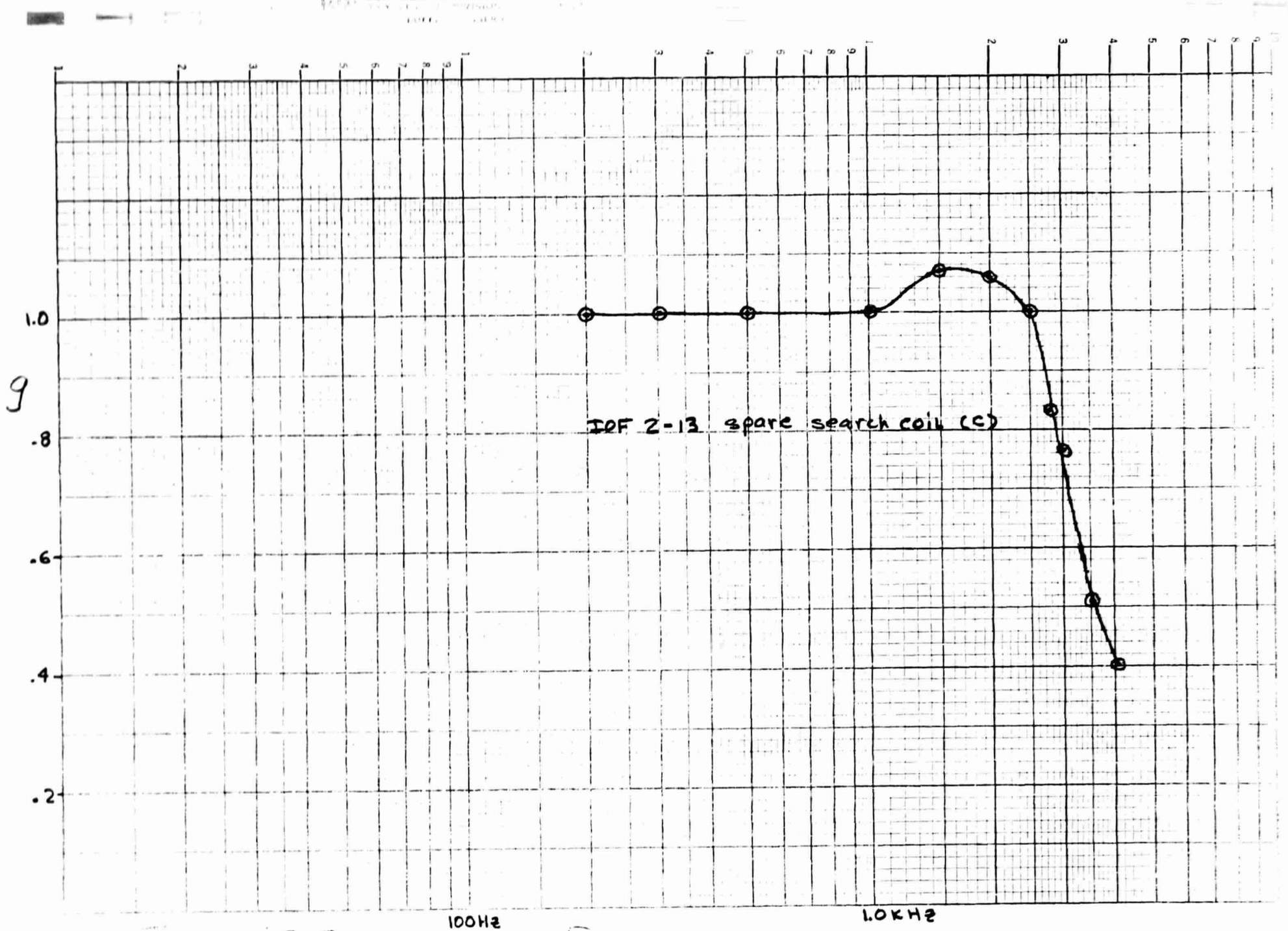


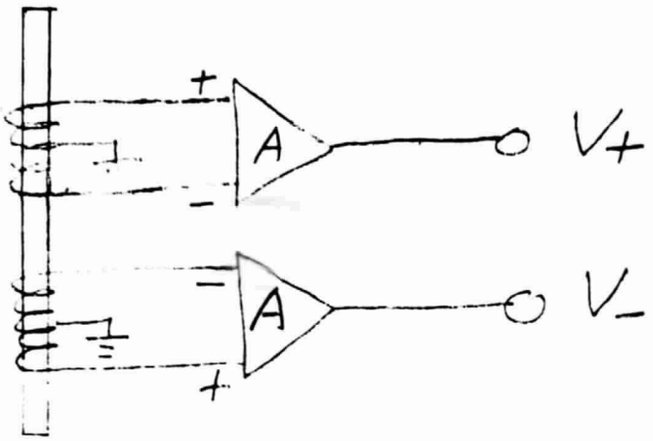
Figure 5-2.3

Figure 5-2.4

The single coil sensitivity, is given by

$$K = \frac{K'}{2A} \quad ,$$

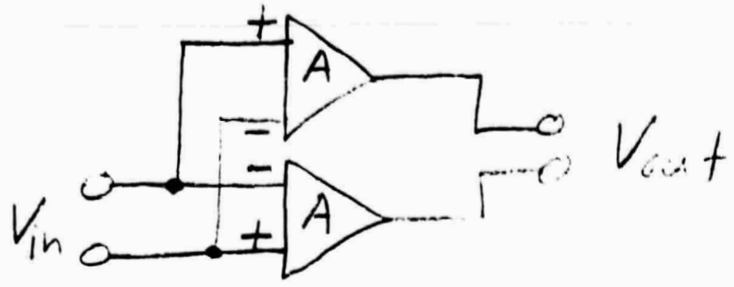
where A is the gain of an individual preamp.



Balanced Outputs

The factor of 2 in the above formula is to account for the fact that two separate coils and preamplifiers are used to produce the balanced differential outputs V_+ and V_-. The polarity of the input to the two preamplifiers is such that two outputs are 180° out of phase, thereby increasing the effective gain by a factor of 2, relative to a single coil/preamplifier system.

The preamplifier gains have been measured as follows



$$A = \frac{V_{out}}{2\ V_{in}}$$

The above configuration is used for all voltage calibrations in which the search coils are disconnected. The preamplifier gains measurements are summarized as follows.

Frequency	X IOF 2-10		Y IOF 2-11		Z IOF 2-12		SPARE IOF 2-13	
	V_{in} mV	V_{out} Volts	V_{in} mV	V_{out} Volts	V_{in} mV	V_{out} Volts	V_{in} mV	V_{out} Volts
100 Hz	79.8	1.46	13.6	250	13.5	249	13.6	250
500 Hz	80.0	1.46	13.7	250	13.6	249	13.7	250
1.00 kHz	80.5	1.47	13.7	250	13.7	249	13.7	249
2.00 kHz	80.5	1.45	13.7	248	13.7	246	13.7	247
4.00 kHz	80.5	1.42	13.7	240	13.7	250	13.7	240
$A_{Average}$	9.300		9.125		9.075		9.075	
$K = \frac{K'}{2A}$	9.02 $\frac{\mu V}{\gamma Hz}$		9.20 $\frac{\mu V}{\gamma Hz}$		9.25 $\frac{\mu V}{\gamma Hz}$		9.25 $\frac{\mu V}{\gamma Hz}$	

The search coil noise levels were determined during the final pre-launch test at the GSFC magnetic test site on September 12, 1973. All 60 Hz power was turned off at the magnetic test site and a μ-metal shield can was placed over the search coil from about 1738 to 1757 UT for purposes of determining the search coil noise levels. Some representative noise levels from the 7-channel magnetic spectrum analyzer during this period are summarized below. The spectrum analyzer is connected to the Bx search coil.

Frequency	IEF Channel	Output Voltage	Equivalent Coil Voltage*
40 Hz	7	1.92 volts	
100 Hz	8	0.60	
178 Hz	9	1.17	
311 Hz	10	0.92	
562 Hz	11	0.35	
1.00 kHz	12	0.25	
1.78 kHz	13	0.25	

*From spectrum analyzer calibration

Since substantial levels of 60 Hz power line interference were evident when the μ-metal shield was removed, it is virtually certain that the 40 Hz and 178 Hz channels were contaminated by power line interference. It is also likely that the noise levels in the 100 Hz and 311 Hz channels are due to power line interference.

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5.3 Spectrum Analyzer Calibrations

IMP-J FILTER BANDWIDTHS

Filter Frequency	Average Input Spectral Density	BW Sp. Density Averaged Over	V_{out}	V_{in} (sine)	V^2_{in} (sine)	BW	% BW
IEF							
45 Hz	$3.16 \times 10^{-8} \frac{V^2}{Hz}$	30 - 60 Hz	2.75	-53 db	5.012×10^{-6}	158.61 Hz	352.5%
100 Hz	5.46×10^{-8}	90 -120 Hz	3.52	-39 db	1.259×10^{-4}	2.3059 kHz	230.6%
178 Hz	8.54×10^{-8}	150-220 Hz	3.02	-49.6 db	1.096×10^{-5}	1.2834×10^{2} Hz	72 %
311 Hz	11.27×10^{-8}	260-370 Hz	3.12	-50.8 db	8.319×10^{-6}	73.815 Hz	24 %
562 Hz	13.97×10^{-8}	480-680 Hz	3.20	-50 db	1.000×10^{-5}	71.582 Hz	12.7%
10 kHz	14.45×10^{-8}	840-1200 Hz	3.32	-48 db	1.585×10^{-5}	1.0969×10^{2} Hz	11 %
1.78 kHz	13.76×10^{-8}	1.5-2.1 kHz	3.32	-48 db	2.513×10^{-5}	1.8263×10^{2} Hz	10.3%
SPF							
5.6 kHz	11.77×10^{-8}	5.1-6.1 kHz	3.35	-43 db	5.008×10^{-5}	4.2544×10^{2} Hz	7.6%
10 kHz	10.84×10^{-8}	9.5-11.0 kHz	3.67	-40.4 db	9.122×10^{-5}	8.4059×10^{2} Hz	8.4%
16 kHz	10.15×10^{-8}	15.0-18.0 kHz	3.92	-37 db	1.996×10^{-4}	1.9665 kHz	12.3%
22 kHz	9.73×10^{-8}	20 - 25 kHz	3.97	-36 db	2.512×10^{-4}	2.5817 kHz	11.7%
31 kHz	9.28×10^{-8}	28 - 34 kHz	4.05	-35 db	3.163×10^{-4}	3.4084 kHz	11.0%
56 kHz	8.67×10^{-8}	51 - 61 kHz	4.20	-32 db	6.310×10^{-4}	7.2779 kHz	130 %
100 kHz	5.99×10^{-8}	90 -110 kHz	4.25	-31.50 db	7.014×10^{-4}	11.709 kHz	11.7%
178 kHz	4.93×10^{-10}*	160-190 kHz	2.82	-56.75 db	2.114×10^{-6}	4.2880 kHz	2.4%
WBR							
01 kHz (Ex)	11.54×10^{-8}	0-1.0 kHz	3.42	-36 db	2.512×10^{-4}	2.1767 kHz	435 %
31.1 kHz	9.27×10^{-10}	30- 32 kHz	3.17	-17.43 db**	1.807×10^{-6}	1.949 kHz	6.3%
125 kHz	1.31×10^{-10}	124-126 kHz	3.30	-26.57 db**	2.203×10^{-7}	1.6816 kHz	1.3%
500 kHz	--	--	1.92				
2000 kHz	--	--	2.17				

* extrapolated
** db below 10 mV

562 Hz, 1.0 kHz, 1.78 kHz IEF lines look o.k.
5.6 kHz and 10 kHz have lower % bandwidths than 16 K → 100 kHz
The extrapolation for the 178 kHz channel was bad % BW much too low
The 0.1 WBD much too wide, probably because of noise
31.1 and 125 kHz look reasonable.

IMP J 2dB CALIBRATION

Channel IEF-0 40 Hz Attenuator in dB Below 1.0 V rms

Dates: Hot 196 Temperature: Hot 30.8°C

Room 203 Room 24.9°C

Cold 195 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.05 / 5.10	5.05 / 5.05	5.02 / 5.10	-46	3.17 / 3.20	3.17 / 3.20	3.15 / 3.12	-92	.80 / .62	.80 / .60	.77 / .65
-2	5.05 / 5.10	5.05 / 5.13	5.02 / 5.10	-48	3.07 / 3.10	3.07 / 3.07	3.05 / 3.05	-94	.75 / .57	.70 / .45	.72 / .55
-4	5.05 / 5.07	5.05 / 5.05	5.00 / 5.10	-50	2.97 / 3.00	2.95 / 2.92	2.92 / 2.95	-96	.70 / .45	.65 / .60	.67 / .40
-6	5.00 / 5.02	5.00 / 5.01	4.97 / 5.05	-52	2.80 / 2.82	2.77 / 2.82	2.77 / 2.77	-98	.60 / .50	.60 / .35	.55 / .37
-8	4.97 / 4.97	4.97 / 4.97	4.92 / 4.97	-54	2.65 / 2.70	2.65 / 2.62	2.62 / 2.60	-100	.55 / .40	.47 / .32	.47 / .32
-10	4.90 / 4.90	4.90 / 4.92	4.87 / 4.87	-56	2.52 / 2.57	2.52 / 2.57	2.50 / 2.47	-102	.51 / .32	.50 / .27	.50 / .32
-12	4.80 / 4.80	4.80 / 4.85	4.77 / 4.80	-58	2.42 / 2.47	2.42 / 2.40	2.40 / 2.40	-104	.47 / .32	.45 / .30	.45 / .25
-14	4.72 / 4.70	4.72 / 4.72	4.70 / 4.75	-60	2.35 / 2.32	2.32 / 2.32	2.30 / 2.35	-106	.47 / .27	.45 / .40	.42 / .22
-16	4.65 / 4.62	4.65 / 4.67	4.60 / 4.70	-62	2.22 / 2.25	2.25 / 2.30	2.22 / 2.25	-108	.45 / .27	.40 / .30	.37 / .25
-18	4.57 / 4.55	4.57 / 4.60	4.55 / 4.62	-64	2.17 / 2.17	2.17 / 2.15	2.15 / 2.17	-110	.52 / .25	.47 / .22	.45 / .20
-20	4.50 / 4.50	4.50 / 4.52	4.47 / 4.45	-66	2.10 / 2.10	2.10 / 2.12	2.05 / 2.05	-112	.45 / .30	.40 / .27	.37 / .25
-22	4.42 / 4.42	4.42 / 4.45	4.40 / 4.40	-68	2.00 / 2.00	2.00 / 1.97	1.97 / 1.95	-114	.42 / .32	.40 / .35	.45 / .20
-24	4.35 / 4.37	4.35 / 4.37	4.32 / 4.35	-70	1.90 / 1.87	1.87 / 1.85	1.85 / 1.85	-116	.40 / .40	.40 / .27	.37 / .30
-26	4.25 / 4.30	4.27 / 4.27	4.25 / 4.30	-72	1.72 / 1.72	1.72 / 1.72	1.70 / 1.67	-118	.42 / .35	.42 / .22	.45 / .27
-28	4.17 / 4.20	4.17 / 4.22	4.15 / 4.22	-74	1.60 / 1.60	1.57 / 1.55	1.55 / 1.55	-120	.40 / .37	.35 / .25	.47 / .25
-30	4.05 / 4.10	4.05 / 4.10	4.02 / 4.00	-76	1.47 / 1.45	1.47 / 1.47	1.42 / 1.42	-122	/	/	/
-32	3.87 / 3.95	3.87 / 3.87	3.85 / 3.85	-78	1.37 / 1.37	1.35 / 1.32	1.32 / 1.32	-124	/	/	/
-34	3.72 / 3.80	3.72 / 3.80	3.70 / 3.72	-80	1.27 / 1.27	1.27 / 1.27	1.25 / 1.22	-126	/	/	/
-36	3.62 / 3.67	3.62 / 3.60	3.57 / 3.62	-82	1.20 / 1.17	1.20 / 1.15	1.15 / 1.10	-128	/	/	/
-38	3.52 / 3.57	3.52 / 3.57	3.47 / 3.52	-84	1.12 / 1.12	1.12 / 1.10	1.07 / 1.05	-130	/	/	/
-40	3.42 / 3.47	3.42 / 3.45	3.40 / 3.40	-86	1.05 / 1.02	1.05 / 1.00	1.02 / .70	-132	/	/	/
-42	3.35 / 3.37	3.35 / 3.37	3.30 / 3.30	-88	1.00 / .82	1.00 / .92	.95 / .85	Noise	.42 / .30	.42 / .32	.37 / .27
-44	3.27 / 3.27	3.25 / 3.27	3.22 / 3.20	-90	.90 / .77	.87 / .77	.87 / .75				

IMP J 2dB CALIBRATION

Channel IEF-0 40 Hz Attenuator in dB Below 1.0 V rms

Dates: Hot 196
Room 203
Cold 195

Temperature: Hot 30.8°C
Room 24.9°C
Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.05 / 5.10	5.05 / 5.05	5.02 / 5.10	-46	3.17 / 3.20	3.17 / 3.20	3.15 / 3.12	-92	.80 / .62	.80 / .60	.77 / .65
-2	5.05 / 5.10	5.05 / 5.13	5.02 / 5.10	-48	3.07 / 3.10	3.07 / 3.01	3.05 / 3.05	-94	.75 / .57	.70 / .45	.72 / .55
-4	5.05 / 5.07	5.05 / 5.05	5.00 / 5.10	-50	2.97 / 3.00	2.95 / 2.92	2.92 / 2.95	-96	.70 / .45	.65 / .60	.67 / .40
-6	5.00 / 5.02	5.00 / 5.01	4.97 / 5.05	-52	2.80 / 2.82	2.77 / 2.82	2.77 / 2.77	-98	.60 / .50	.60 / .35	.55 / .37
-8	4.97 / 4.97	4.97 / 4.97	4.92 / 4.97	-54	2.65 / 2.70	2.65 / 2.62	2.62 / 2.60	-100	.55 / .40	.47 / .32	.47 / .32
-10	4.90 / 4.90	4.90 / 4.92	4.87 / 4.87	-56	2.52 / 2.57	2.52 / 2.57	2.50 / 2.47	-102	.57 / .32	.50 / .27	.50 / .32
-12	4.80 / 4.80	4.80 / 4.85	4.77 / 4.80	-58	2.42 / 2.47	2.42 / 2.40	2.40 / 2.40	-104	.47 / .32	.45 / .30	.45 / .25
-14	4.72 / 4.70	4.72 / 4.72	4.70 / 4.75	-60	2.35 / 2.32	2.32 / 2.32	2.30 / 2.35	-106	.47 / .27	.45 / .40	.42 / .22
-16	4.65 / 4.62	4.65 / 4.67	4.60 / 4.70	-62	2.22 / 2.25	2.25 / 2.30	2.22 / 2.25	-108	.45 / .27	.40 / .30	.37 / .25
-18	4.57 / 4.55	4.57 / 4.60	4.55 / 4.62	-64	2.17 / 2.17	2.17 / 2.15	2.15 / 2.17	-110	.52 / .25	.47 / .22	.45 / .20
-20	4.50 / 4.50	4.50 / 4.52	4.47 / 4.45	-66	2.10 / 2.10	2.10 / 2.12	2.05 / 2.05	-112	.45 / .30	.40 / .27	.37 / .25
-22	4.42 / 4.42	4.42 / 4.45	4.40 / 4.40	-68	2.00 / 2.00	2.00 / 1.97	1.97 / 1.95	-114	.42 / .32	.40 / .35	.45 / .20
-24	4.35 / 4.37	4.35 / 4.37	4.32 / 4.35	-70	1.90 / 1.87	1.87 / 1.89	1.85 / 1.85	-116	.40 / .40	.40 / .27	.37 / .30
-26	4.25 / 4.30	4.27 / 4.27	4.25 / 4.30	-72	1.72 / 1.72	1.72 / 1.72	1.70 / 1.67	-118	.42 / .35	.42 / .22	.45 / .27
-28	4.17 / 4.20	4.17 / 4.22	4.15 / 4.22	-74	1.60 / 1.60	1.57 / 1.55	1.55 / 1.55	-120	.40 / .37	.45 / .25	.47 / .25
-30	4.05 / 4.10	4.05 / 4.10	4.02 / 4.00	-76	1.47 / 1.45	1.47 / 1.47	1.42 / 1.42	-122			
-32	3.87 / 3.95	3.87 / 3.87	3.85 / 3.85	-78	1.37 / 1.37	1.35 / 1.32	1.32 / 1.32	-124			
-34	3.72 / 3.80	3.72 / 3.80	3.70 / 3.72	-80	1.27 / 1.27	1.27 / 1.27	1.25 / 1.22	-126			
-36	3.62 / 3.67	3.62 / 3.60	3.57 / 3.62	-82	1.20 / 1.17	1.20 / 1.15	1.15 / 1.10	-128			
-38	3.52 / 3.57	3.52 / 3.57	3.47 / 3.52	-84	1.12 / 1.12	1.12 / 1.10	1.07 / 1.05	-130			
-40	3.42 / 3.47	3.42 / 3.45	3.40 / 3.40	-86	1.05 / 1.02	1.05 / 1.00	1.02 / .70	-132			
-42	3.35 / 3.37	3.35 / 3.37	3.30 / 3.30	-88	1.00 / .82	1.00 / .92	.95 / .85	Noise	.42 / .30	.42 / .32	.37 / .27
-44	3.27 / 3.27	3.25 / 3.27	3.22 / 3.20	-90	.90 / .77	.87 / .77	.87 / .75				

IMP J 2dB CALIBRATION

Channel IEF-1 100Hz Attenuator in dB Below 1.0 V rms

Dates: Hot 196
Room 203
Cold 195

Temperature: Hot 30.8°C
Room 24.9°C
Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.97 / 5.05	4.97 / 5.05	4.95 / 5.05	-46	3.17 / 3.25	3.17 / 3.22	3.15 / 3.20	-92	.77 / .67	.77 / .70	.75 / .67
-2	4.97 / 5.05	4.97 / 5.05	4.95 / 5.02	-48	3.07 / 3.15	3.10 / 3.15	3.01 / 3.12	-94	.65 / .57	.65 / .62	.65 / .55
-4	4.97 / 5.05	4.97 / 5.05	4.95 / 5.00	-50	2.97 / 3.00	2.97 / 3.02	2.95 / 3.02	-96	.55 / .50	.55 / .42	.55 / .45
-6	4.97 / 5.05	4.97 / 5.05	4.95 / 5.00	-52	2.82 / 2.87	2.82 / 2.87	2.82 / 2.87	-98	.47 / .32	.52 / .37	.45 / .37
-8	4.95 / 5.02	4.95 / 5.00	4.92 / 5.00	-54	2.67 / 2.72	2.61 / 2.72	2.65 / 2.70	-100	.40 / .30	.37 / .30	.37 / .27
-10	4.90 / 4.97	4.90 / 4.97	4.87 / 4.95	-56	2.55 / 2.60	2.55 / 2.60	2.52 / 2.55	-102	.37 / .25	.37 / .32	.32 / .25
-12	4.82 / 4.90	4.82 / 4.87	4.80 / 4.90	-58	2.45 / 2.47	2.45 / 2.47	2.42 / 2.45	-104	.30 / .25	.27 / .20	.27 / .15
-14	4.72 / 4.80	4.72 / 4.80	4.70 / 4.80	-60	2.35 / 2.31	2.35 / 2.40	2.32 / 2.35	-106	.25 / .20	.27 / .17	.25 / .17
-16	4.62 / 4.70	4.65 / 4.70	4.62 / 4.67	-62	2.27 / 2.30	2.27 / 2.30	2.22 / 2.27	-108	.25 / .20	.25 / .17	.22 / .12
-18	4.55 / 4.60	4.55 / 4.60	4.52 / 4.57	-64	2.17 / 2.22	2.17 / 2.22	2.15 / 2.20	-110	.25 / .20	.25 / .17	.20 / .12
-20	4.45 / 4.52	4.47 / 4.52	4.45 / 4.50	-66	2.10 / 2.15	2.10 / 2.15	2.07 / 2.12	-112	.22 / .17	.22 / .17	.20 / .01
-22	4.37 / 4.45	4.40 / 4.45	4.37 / 4.42	-68	2.02 / 2.05	2.02 / 2.05	2.00 / 2.00	-114	.25 / .15	.22 / .15	.17 / .10
-24	4.30 / 4.40	4.32 / 4.40	4.30 / 4.35	-70	1.90 / 1.92	1.90 / 1.95	1.87 / 1.92	-116	.22 / .17	.20 / .12	.20 / .12
-26	4.22 / 4.30	4.22 / 4.27	4.22 / 4.30	-72	1.75 / 1.77	1.75 / 1.77	1.75 / 1.77	-118	.22 / .12	.22 / .15	.20 / .12
-28	4.15 / 4.20	4.15 / 4.22	4.12 / 4.20	-74	1.60 / 1.62	1.60 / 1.62	1.60 / 1.60	-120	.20 / .17	.22 / .22	.20 / .12
-30	4.02 / 4.10	4.05 / 4.10	4.02 / 4.10	-76	1.47 / 1.50	1.47 / 1.50	1.45 / 1.47	-122			
-32	3.81 / 3.95	3.90 / 3.97	3.81 / 3.92	-78	1.37 / 1.40	1.37 / 1.40	1.35 / 1.37	-124			
-34	3.72 / 3.80	3.75 / 3.80	3.72 / 3.77	-80	1.30 / 1.30	1.27 / 1.30	1.25 / 1.27	-126			
-36	3.60 / 3.67	3.62 / 3.67	3.60 / 3.67	-82	1.20 / 1.22	1.20 / 1.22	1.17 / 1.20	-128			
-38	3.50 / 3.55	3.50 / 3.57	3.50 / 3.55	-84	1.12 / 1.12	1.12 / 1.15	1.10 / 1.10	-130			
-40	3.42 / 3.47	3.42 / 3.47	3.40 / 3.45	-86	1.05 / 1.05	1.05 / 1.05	1.02 / 1.00	-132			
-42	3.32 / 3.37	3.35 / 3.37	3.30 / 3.35	-88	.97 / .97	.97 / .97	.95 / .90	Noise	.20 / .12	.20 / .15	.17 / .10
-44	3.25 / 3.32	3.25 / 3.32	3.22 / 3.27	-90	.87 / .87	.90 / .87	.87 / .80				

IMP J 2dB CALIBRATION

Channel JEF-2 178Hz Attenuator in dB Below 1.0 V rms

Dates: Hot 196 Temperature: Hot +30°C

Room 203 Room

Cold 195 Cold -20°C

ATTEN	Peak / Ave HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.97 / 5.05	4.97 / 5.05	4.95 / 5.02	-46	3.15 / 3.20	3.15 / 3.20	3.10 / 3.12	-92	.77 / .72	.77 / .70	.67 / .65
-2	4.97 / 5.05	4.97 / 5.05	4.95 / 5.02	-48	3.07 / 3.12	3.07 / 3.12	3.00 / 3.05	-94	.62 / .57	.62 / .60	.55 / .52
-4	4.97 / 5.05	4.97 / 5.02	4.92 / 5.00	-50	2.97 / 3.00	2.95 / 3.00	2.87 / 2.92	-96	.52 / .50	.52 / .45	.45 / .40
-6	4.95 / 5.02	4.95 / 5.02	4.92 / 5.00	-52	2.80 / 2.85	2.80 / 2.85	2.72 / 2.75	-98	.42 / .40	.42 / .35	.37 / .32
-8	4.92 / 5.00	4.92 / 5.00	4.87 / 4.95	-54	2.65 / 2.70	2.65 / 2.70	2.57 / 2.62	-100	.37 / .30	.37 / .30	.32 / .22
-10	4.87 / 4.95	4.87 / 4.95	4.82 / 4.90	-56	2.52 / 2.57	2.52 / 2.57	2.45 / 2.50	-102	.30 / .25	.32 / .27	.25 / .20
-12	4.80 / 4.85	4.80 / 4.87	4.72 / 4.80	-58	2.42 / 2.47	2.42 / 2.47	2.35 / 2.40	-104	.30 / .25	.27 / .20	.22 / .15
-14	4.70 / 4.77	4.70 / 4.77	4.62 / 4.70	-60	2.35 / 2.37	2.32 / 2.37	2.27 / 2.30	-106	.25 / .17	.25 / .17	.20 / .12
-16	4.60 / 4.67	4.60 / 4.67	4.55 / 4.62	-62	2.25 / 2.30	2.25 / 2.30	2.17 / 2.22	-108	.22 / .17	.22 / .15	.17 / .12
-18	4.52 / 4.57	4.52 / 4.57	4.47 / 4.52	-64	2.17 / 2.22	2.17 / 2.20	2.10 / 2.12	-110	.20 / .17	.22 / .15	.15 / .10
-20	4.42 / 4.50	4.42 / 4.50	4.40 / 4.45	-66	2.10 / 2.12	2.10 / 2.12	2.02 / 2.05	-112	.22 / .17	.20 / .15	.15 / .12
-22	4.35 / 4.42	4.35 / 4.42	4.30 / 4.37	-68	2.00 / 2.05	2.00 / 2.02	1.92 / 1.95	-114	.20 / .15	.20 / .15	.12 / .12
-24	4.27 / 4.35	4.27 / 4.35	4.22 / 4.30	-70	1.90 / 1.92	1.90 / 1.92	1.82 / 1.85	-116	.20 / .17	.20 / .15	.15 / .10
-26	4.20 / 4.27	4.20 / 4.27	4.15 / 4.22	-72	1.75 / 1.77	1.75 / 1.77	1.65 / 1.67	-118	.17 / .15	.20 / .20	.15 / .10
-28	4.12 / 4.17	4.12 / 4.17	4.07 / 4.12	-74	1.60 / 1.62	1.60 / 1.60	1.52 / 1.52	-120	.20 / .15	.20 / .12	.15 / .10
-30	4.00 / 4.07	4.00 / 4.01	3.95 / 4.00	-76	1.47 / 1.50	1.47 / 1.47	1.40 / 1.40	-122			
-32	3.85 / 3.92	3.85 / 3.92	3.77 / 3.85	-78	1.37 / 1.40	1.37 / 1.37	1.30 / 1.30	-124			
-34	3.70 / 3.77	3.70 / 3.77	3.65 / 3.70	-80	1.27 / 1.30	1.27 / 1.30	1.20 / 1.22	-126			
-36	3.60 / 3.65	3.57 / 3.65	3.52 / 3.57	-82	1.20 / 1.20	1.20 / 1.20	1.12 / 1.12	-128			
-38	3.47 / 3.55	3.47 / 3.55	3.42 / 3.47	-84	1.12 / 1.12	1.12 / 1.12	1.05 / 1.07	-130			
-40	3.40 / 3.42	3.40 / 3.45	3.32 / 3.37	-86	1.05 / 1.05	1.05 / 1.05	.97 / .97	-132			
-42	3.32 / 3.37	3.32 / 3.37	3.25 / 3.30	-88	.97 / .97	.97 / .95	.90 / .90	Noise	.17 / .15	.17 / .17	.12 / .10
-44	3.25 / 3.30	3.22 / 3.27	3.17 / 3.22	-90	.87 / .87	.87 / .82	.80 / .75				

IMP J 2dB CALIBRATION

Channel IEF 3 311Hz Attenuator in dB Below 1.0 V rms

Dates: Hot 196 Temperature: Hot +30°C

Room 203 Room

Cold 195 Cold -20°C

Peak / Ave

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.95 / 5.02	4.95 / 5.02	4.92 / 5.00	-46	3.25 / 3.32	3.27 / 3.32	2.22 / 3.30	-92	.70 / .70	.72 / .90	.90 / .90
-2	4.95 / 5.02	4.95 / 5.02	4.92 / 5.00	-48	3.17 / 3.22	3.17 / 3.25	3.15 / 3.20	-94	.80 / .75	.80 / .75	.80 / .80
-4	4.95 / 5.02	4.95 / 5.02	4.92 / 5.00	-50	3.10 / 3.15	3.10 / 3.15	3.07 / 3.12	-96	.65 / .62	.67 / .65	.67 / .65
-6	4.95 / 5.02	4.95 / 5.02	4.92 / 5.00	-52	3.00 / 3.05	3.00 / 3.01	2.97 / 3.02	-98	.55 / .50	.57 / .55	.57 / .50
-8	4.92 / 5.02	4.92 / 5.02	4.90 / 5.00	-54	2.87 / 2.92	2.87 / 2.95	2.87 / 2.92	-100	.45 / .42	.47 / .45	.47 / .45
-10	4.92 / 5.00	4.92 / 5.00	4.90 / 4.97	-56	2.70 / 2.75	2.72 / 2.77	2.70 / 2.75	-102	.37 / .35	.40 / .30	.37 / .32
-12	4.87 / 4.95	4.87 / 4.95	4.85 / 4.92	-58	2.57 / 2.62	2.57 / 2.62	2.57 / 2.60	-104	.32 / .32	.35 / .30	.32 / .27
-14	4.82 / 4.90	4.82 / 4.90	4.80 / 4.87	-60	2.45 / 2.50	2.47 / 2.52	2.45 / 2.50	-106	.30 / .25	.30 / .25	.27 / .20
-16	4.72 / 4.80	4.72 / 4.80	4.70 / 4.77	-62	2.37 / 2.40	2.37 / 2.42	2.35 / 2.40	-108	.25 / .20	.25 / .22	.22 / .22
-18	4.62 / 4.70	4.62 / 4.70	4.60 / 4.67	-64	2.27 / 2.32	2.30 / 2.32	2.25 / 2.30	-110	.22 / .20	.25 / .17	.20 / .17
-20	4.55 / 4.62	4.55 / 4.62	4.52 / 4.60	-66	2.20 / 2.25	2.20 / 2.25	2.17 / 2.22	-112	.20 / .20	.22 / .20	.20 / .12
-22	4.47 / 4.55	4.47 / 4.55	4.45 / 4.52	-68	2.12 / 2.15	2.12 / 2.17	2.10 / 2.12	-114	.20 / .15	.20 / .20	.17 / .15
-24	4.37 / 4.45	4.37 / 4.45	4.37 / 4.45	-70	2.02 / 2.07	2.05 / 2.07	2.02 / 2.05	-116	.20 / .17	.20 / .17	.17 / .15
-26	4.30 / 4.37	4.30 / 4.37	4.30 / 4.37	-72	1.92 / 1.97	1.95 / 1.97	1.92 / 1.95	-118	.20 / .15	.20 / .17	.17 / .15
-28	4.22 / 4.30	4.22 / 4.30	4.22 / 4.30	-74	1.80 / 1.85	1.82 / 1.85	1.82 / 1.85	-120	.20 / .17	.20 / .17	.17 / .15
-30	4.15 / 4.22	4.15 / 4.22	4.12 / 4.20	-76	1.65 / 1.67	1.67 / 1.70	1.65 / 1.67	-122			
-32	4.05 / 4.12	4.05 / 4.12	4.05 / 4.12	-78	1.50 / 1.55	1.52 / 1.55	1.52 / 1.55	-124			
-34	3.92 / 4.00	3.92 / 4.00	3.92 / 4.00	-80	1.40 / 1.42	1.42 / 1.42	1.40 / 1.42	-126			
-36	3.77 / 3.82	3.77 / 3.85	3.77 / 3.85	-82	1.30 / 1.32	1.32 / 1.35	1.30 / 1.30	-128			
-38	3.62 / 3.70	3.65 / 3.70	3.62 / 3.70	-84	1.22 / 1.25	1.22 / 1.25	1.20 / 1.22	-130			
-40	3.52 / 3.57	3.52 / 3.60	3.50 / 3.57	-86	1.15 / 1.17	1.15 / 1.17	1.12 / 1.12	-132			
-42	3.42 / 3.47	3.42 / 3.50	3.40 / 3.45	-88	1.07 / 1.07	1.07 / 1.10	1.05 / 1.05	Noise	.20 / .17	.17 / .15	.15 / .10
-44	3.32 / 3.40	3.35 / 3.40	3.32 / 3.37	-90	1.00 / 1.00	1.00 / 1.02	.97 / .97				

IMP J 2dB CALIBRATION

Channel IEF 4 (560 Hz) Attenuator in dB Below 1 V rms

Dates: Hot 196 Temperature: Hot +30°C

Room 203 Room

Cold 195 Cold -20°C

Peak / Ave

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.95 / 5.05	4.95 / 5.05	4.95 / 5.05	-46	3.30 / 3.37	3.30 / 3.36	3.25 / 3.32	-92	.95 / .87	.95 / .95	.90 / .90
-2	4.95 / 5.05	4.95 / 5.05	4.95 / 5.05	-48	3.22 / 3.30	3.22 / 3.27	3.17 / 3.25	-94	.85 / .85	.85 / .82	.82 / .80
-4	4.95 / 5.05	4.95 / 5.05	4.95 / 5.05	-50	3.15 / 3.20	3.12 / 3.20	3.10 / 3.15	-96	.72 / .67	.70 / .70	.67 / .65
-6	4.95 / 5.02	4.95 / 5.02	4.95 / 5.05	-52	3.12 / 3.15	3.05 / 3.10	3.00 / 3.07	-98	.60 / .57	.60 / .65	.57 / .50
-8	4.95 / 5.02	4.95 / 5.02	4.95 / 5.02	-54	3.00 / 3.05	2.92 / 3.00	2.90 / 2.95	-100	.50 / .42	.50 / .45	.45 / .42
-10	4.92 / 5.02	4.92 / 5.02	4.92 / 5.02	-56	2.85 / 2.95	2.77 / 2.82	2.75 / 2.80	-102	.40 / .40	.40 / .37	.37 / .32
-12	4.92 / 5.00	4.92 / 5.00	4.90 / 5.00	-58	2.70 / 2.80	2.62 / 2.67	2.60 / 2.65	-104	.35 / .32	.32 / .30	.32 / .25
-14	4.87 / 4.97	4.87 / 4.95	4.85 / 4.92	-60	2.52 / 2.57	2.50 / 2.55	2.47 / 2.52	-106	.30 / .27	.27 / .25	.25 / .20
-16	4.80 / 4.87	4.80 / 4.87	4.75 / 4.85	-62	2.42 / 2.47	2.40 / 2.45	2.35 / 2.40	-108	.25 / .22	.25 / .20	.22 / .17
-18	4.70 / 4.77	4.70 / 4.77	4.65 / 4.75	-64	2.32 / 2.37	2.32 / 2.35	2.27 / 2.32	-110	.22 / .20	.22 / .20	.15 / .12
-20	4.60 / 4.70	4.60 / 4.70	4.57 / 4.65	-66	2.25 / 2.27	2.22 / 2.27	2.20 / 2.22	-112	.20 / .20	.20 / .17	.17 / .10
-22	4.52 / 4.60	4.52 / 4.60	4.50 / 4.57	-68	2.15 / 2.20	2.15 / 2.20	2.10 / 2.15	-114	.17 / .17	.20 / .15	.15 / .10
-24	4.45 / 4.52	4.45 / 4.52	4.42 / 4.50	-70	2.07 / 2.12	2.07 / 2.10	2.02 / 2.07	-116	.17 / .15	.17 / .15	.15 / .12
-26	4.35 / 4.45	4.35 / 4.45	4.32 / 4.42	-72	2.00 / 2.02	1.97 / 2.02	1.95 / 1.97	-118	.17 / .15	.17 / .15	.17 / .12
-28	4.27 / 4.37	4.27 / 4.37	4.25 / 4.32	-74	1.87 / 1.92	1.87 / 1.90	1.82 / 1.87	-120	.17 / .15	.17 / .15	.15 / .12
-30	4.20 / 4.27	4.20 / 4.27	4.17 / 4.25	-76	1.72 / 1.77	1.72 / 1.75	1.67 / 1.70	-122			
-32	4.12 / 4.20	4.12 / 4.20	4.07 / 4.17	-78	1.57 / 1.60	1.57 / 1.60	1.52 / 1.55	-124			
-34	4.00 / 4.07	4.00 / 4.07	3.97 / 4.05	-80	1.45 / 1.47	1.45 / 1.47	1.40 / 1.42	-126			
-36	3.85 / 3.92	3.85 / 3.92	3.82 / 3.90	-82	1.35 / 1.37	1.35 / 1.37	1.30 / 1.32	-128			
-38	3.70 / 3.77	3.70 / 3.77	3.67 / 3.72	-84	1.27 / 1.30	1.25 / 1.27	1.22 / 1.22	-130			
-40	3.57 / 3.67	3.57 / 3.65	3.55 / 3.60	-86	1.17 / 1.20	1.17 / 1.20	1.12 / 1.15	-132			
-42	3.47 / 3.55	3.47 / 3.55	3.42 / 3.50	-88	1.10 / 1.12	1.10 / 1.12	1.05 / 1.07	Noise	.17 / .15	.15 / .12	.12 / .10
-44	3.40 / 3.45	3.37 / 3.45	3.35 / 3.40	-90	1.02 / 1.05	1.02 / 1.05	.97 / 1.00				

IMP J 2dB CALIBRATION

Channel IEF-5 (1 KHz) Attenuator in dB Below 1 V rms

Dates: Hot 196 Temperature: Hot +30°C

Room 203 Room

Cold 195 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.00 / 5.10	5.00 / 5.10	4.97 / 5.07	-46	3.32 / 3.40	3.32 / 3.40	3.30 / 3.37	-92	.95 / .97	.95 / .91	.92 / .95
-2	5.00 / 5.10	5.00 / 5.10	4.97 / 5.07	-48	3.25 / 3.32	3.25 / 3.32	3.22 / 3.27	-94	.86 / .85	.85 / .85	.85 / .82
-4	5.00 / 5.10	5.00 / 5.10	4.97 / 5.07	-50	3.17 / 3.22	3.17 / 3.22	3.15 / 3.20	-96	.70 / .70	.72 / .70	.70 / .67
-6	5.00 / 5.10	5.00 / 5.10	4.97 / 5.07	-52	3.07 / 3.15	3.07 / 3.15	3.05 / 3.12	-98	.60 / .57	.60 / .57	.57 / .55
-8	5.00 / 5.10	5.00 / 5.10	4.97 / 5.07	-54	2.97 / 3.02	2.97 / 3.02	2.95 / 3.00	-100	.47 / .47	.50 / .47	.47 / .47
-10	5.00 / 5.07	5.00 / 5.07	4.97 / 5.07	-56	2.80 / 2.87	2.82 / 2.87	2.80 / 2.85	-102	.40 / .37	.40 / .37	.37 / .35
-12	4.97 / 5.05	4.97 / 5.05	4.95 / 5.02	-58	2.67 / 2.72	2.67 / 2.72	2.65 / 2.70	-104	.35 / .30	.32 / .32	.30 / .27
-14	4.92 / 5.00	4.92 / 5.00	4.90 / 4.97	-60	2.55 / 2.60	2.55 / 2.60	2.52 / 2.57	-106	.27 / .27	.27 / .25	.25 / .22
-16	4.82 / 4.92	4.82 / 4.92	4.80 / 4.90	-62	2.42 / 2.47	2.42 / 2.47	2.40 / 2.45	-108	.25 / .25	.25 / .22	.22 / .20
-18	4.72 / 4.82	4.72 / 4.80	4.70 / 4.80	-64	2.35 / 2.40	2.35 / 2.40	2.32 / 2.37	-110	.22 / .22	.20 / .20	.20 / .17
-20	4.62 / 4.72	4.62 / 4.72	4.60 / 4.70	-66	2.25 / 2.30	2.25 / 2.30	2.22 / 2.27	-112	.20 / .20	.20 / .17	.17 / .15
-22	4.55 / 4.62	4.55 / 4.62	4.52 / 4.60	-68	2.17 / 2.22	2.17 / 2.22	2.15 / 2.20	-114	.20 / .17	.17 / .17	.15 / .12
-24	4.45 / 4.55	4.45 / 4.55	4.45 / 4.52	-70	2.10 / 2.15	2.10 / 2.15	2.07 / 2.10	-116	.17 / .17	.17 / .17	.15 / .15
-26	4.37 / 4.47	4.37 / 4.47	4.35 / 4.45	-72	2.00 / 2.05	2.00 / 2.05	1.97 / 2.02	-118	.17 / .17	.15 / .15	.15 / .12
-28	4.30 / 4.40	4.30 / 4.40	4.27 / 4.37	-74	1.90 / 1.95	1.90 / 1.95	1.87 / 1.92	-120	.17 / .17	.17 / .15	.12 / .12
-30	4.22 / 4.32	4.22 / 4.30	4.20 / 4.27	-76	1.75 / 1.77	1.75 / 1.77	1.72 / 1.77	-122			
-32	4.15 / 4.22	4.15 / 4.22	4.12 / 4.20	-78	1.60 / 1.62	1.60 / 1.62	1.57 / 1.60	-124			
-34	4.02 / 4.12	4.02 / 4.12	4.02 / 4.10	-80	1.47 / 1.50	1.47 / 1.50	1.45 / 1.47	-126			
-36	3.87 / 3.95	3.87 / 3.95	3.87 / 3.95	-82	1.37 / 1.40	1.37 / 1.40	1.35 / 1.37	-128			
-38	3.72 / 3.80	3.72 / 3.80	3.72 / 3.77	-84	1.27 / 1.30	1.27 / 1.30	1.25 / 1.27	-130			
-40	3.60 / 3.67	3.60 / 3.67	3.57 / 3.65	-86	1.20 / 1.22	1.20 / 1.22	1.17 / 1.17	-132			
-42	3.60 / 3.57	3.50 / 3.57	3.47 / 3.55	-88	1.12 / 1.15	1.12 / 1.15	1.10 / 1.10	Noise	.17 / .16	.15 / .15	.12 / .12
-44	3.42 / 3.47	3.42 / 3.47	3.37 / 3.45	-90	1.05 / 1.05	1.05 / 1.05	1.02 / 1.02				

IMP J 2dB CALIBRATION

Channel IEF-6 (1.78 KHz) Attenuator in dB Below 1 V rms

Dates: Hot 196 Temperature: Hot 130°C

Room 203 Room

Cold 195 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.97 / 5.07	4.97 / 5.07	5.00 / 5.07	-46	3.27 / 3.35	3.27 / 3.32	3.25 / 3.30	-92	.90 / .92	.90 / .92	.90 / .90
-2	4.97 / 5.07	4.97 / 5.07	5.00 / 5.07	-48	3.20 / 3.25	3.17 / 3.25	3.17 / 3.22	-94	.80 / .82	.80 / .80	.77 / .77
-4	4.97 / 5.07	4.97 / 5.07	4.97 / 5.07	-50	3.10 / 3.17	3.10 / 3.17	3.07 / 3.15	-96	.65 / .67	.65 / .65	.65 / .65
-6	4.97 / 5.07	4.97 / 5.07	4.97 / 5.07	-52	3.00 / 3.07	3.00 / 3.07	3.00 / 3.05	-98	.55 / .55	.52 / .55	.52 / .52
-8	4.97 / 5.07	4.97 / 5.07	4.97 / 5.07	-54	2.87 / 2.95	2.87 / 2.95	2.87 / 2.92	-100	.45 / .45	.42 / .42	.45 / .42
-10	4.95 / 5.05	4.95 / 5.05	4.97 / 5.05	-56	2.72 / 2.77	2.72 / 2.77	2.70 / 2.75	-102	.37 / .35	.35 / .35	.35 / .35
-12	4.92 / 5.02	4.92 / 5.02	4.92 / 5.02	-58	2.57 / 2.65	2.57 / 2.65	2.57 / 2.62	-104	.30 / .32	.30 / .30	.27 / .27
-14	4.85 / 4.95	4.87 / 4.95	4.81 / 4.95	-60	2.47 / 2.52	2.47 / 2.52	2.45 / 2.50	-106	.25 / .25	.25 / .25	.25 / .22
-16	4.75 / 4.85	4.75 / 4.85	4.75 / 4.85	-62	2.37 / 2.42	2.37 / 2.42	2.35 / 2.40	-108	.22 / .22	.22 / .20	.20 / .20
-18	4.65 / 4.72	4.65 / 4.72	4.65 / 4.75	-64	2.30 / 2.35	2.27 / 2.32	2.25 / 2.30	-110	.20 / .20	.20 / .20	.17 / .17
-20	4.55 / 4.62	4.55 / 4.62	4.55 / 4.62	-66	2.20 / 2.25	2.20 / 2.25	2.17 / 2.22	-112	.20 / .20	.17 / .17	.17 / .15
-22	4.45 / 4.55	4.45 / 4.55	4.45 / 4.55	-68	2.12 / 2.17	2.12 / 2.17	2.10 / 2.15	-114	.17 / .17	.17 / .17	.15 / .15
-24	4.37 / 4.47	4.37 / 4.47	4.37 / 4.45	-70	2.05 / 2.10	2.05 / 2.10	2.02 / 2.05	-116	.17 / .17	.15 / .15	.15 / .12
-26	4.30 / 4.40	4.30 / 4.40	4.30 / 4.37	-72	1.95 / 2.00	1.95 / 2.00	1.92 / 1.97	-118	.17 / .17	.15 / .15	.12 / .12
-28	4.22 / 4.32	4.22 / 4.32	4.22 / 4.30	-74	1.82 / 1.87	1.82 / 1.87	1.82 / 1.85	-120	.17 / .17	.15 / .15	.12 / .12
-30	4.15 / 4.22	4.15 / 4.22	4.12 / 4.22	-76	1.67 / 1.70	1.67 / 1.70	1.65 / 1.70	-122			
-32	4.05 / 4.15	4.05 / 4.12	4.05 / 4.12	-78	1.52 / 1.57	1.52 / 1.57	1.50 / 1.55	-124			
-34	3.92 / 4.00	3.92 / 4.00	3.92 / 4.00	-80	1.42 / 1.45	1.42 / 1.45	1.40 / 1.42	-126			
-36	3.75 / 3.85	3.75 / 3.85	3.75 / 3.82	-82	1.32 / 1.35	1.32 / 1.35	1.30 / 1.32	-128			
-38	3.62 / 3.70	3.62 / 3.70	3.62 / 3.70	-84	1.25 / 1.27	1.22 / 1.25	1.20 / 1.22	-130			
-40	3.52 / 3.60	3.52 / 3.60	3.50 / 3.57	-86	1.15 / 1.17	1.15 / 1.17	1.12 / 1.15	-132			
-42	3.42 / 3.50	3.42 / 3.50	3.40 / 3.47	-88	1.07 / 1.10	1.07 / 1.10	1.05 / 1.07	Noise	.15 / .15	.15 / .15	.12 / .12
-44	3.35 / 3.42	3.35 / 3.42	3.32 / 3.40	-90	1.00 / 1.02	1.00 / 1.02	.97 / 1.00				

IMP J 2dB CALIBRATION

Channel IEF-7 (40 Hz) Attenuator in dB Below .1 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 202 Room

Cold 195 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.10 / 5.07	5.10 / 5.10	5.07 / 5.07	-46	3.70 / 3.72	3.72 / 3.77	3.67 / 3.70	-92	2.22 / 2.25	1.70 / 1.70	2.25 / 2.27
-2	5.10 / 5.13	5.10 / 5.13	5.07 / 5.07	-48	3.60 / 3.65	3.60 / 3.60	3.55 / 3.60	-94	2.22 / 2.22	1.70 / 1.67	2.25 / 2.30
-4	5.10 / 5.18	5.13 / 5.20	5.07 / 5.13	-50	3.50 / 3.50	3.50 / 3.52	3.45 / 3.45	-96	2.22 / 2.25	1.67 / 1.70	2.25 / 2.27
-6	5.10 / 5.13	5.13 / 5.18	5.07 / 5.15	-52	3.40 / 3.42	3.42 / 3.42	3.37 / 3.42	-98	2.22 / 2.25	1.67 / 1.67	2.25 / 2.27
-8	5.10 / 5.10	5.13 / 5.13	5.07 / 5.13	-54	3.32 / 3.40	3.35 / 3.32	3.27 / 3.32	-100	2.22 / 2.25	1.67 / 1.70	2.25 / 2.27
-10	5.10 / 5.15	5.13 / 5.18	5.07 / 5.10	-56	3.25 / 3.30	3.25 / 3.32	3.20 / 3.20	-102	2.22 / 2.25	1.67 / 1.70	2.25 / 2.27
-12	5.10 / 5.15	5.13 / 5.18	5.07 / 5.13	-58	3.17 / 3.17	3.17 / 3.20	3.12 / 3.10	-104	2.22 / 2.22	1.67 / 1.67	2.25 / 2.27
-14	5.07 / 5.10	5.10 / 5.13	5.07 / 5.15	-60	3.07 / 3.12	3.07 / 3.10	3.02 / 3.07	-106	2.22 / 2.25	1.67 / 1.67	2.25 / 2.30
-16	5.07 / 5.05	5.10 / 5.07	5.05 / 5.07	-62	2.95 / 2.97	2.75 / 3.00	2.90 / 2.95	-108	2.22 / 2.25	1.67 / 1.70	2.25 / 2.27
-18	5.02 / 5.07	5.05 / 5.10	5.00 / 5.00	-64	2.82 / 2.82	2.80 / 2.80	2.77 / 2.72	-110	2.22 / 2.22	1.67 / 1.70	2.25 / 2.27
-20	4.97 / 5.02	5.00 / 5.02	4.95 / 5.02	-66	2.67 / 2.62	2.65 / 2.65	2.65 / 2.60	-112	2.22 / 2.25	1.67 / 1.70	2.25 / 2.27
-22	4.92 / 4.92	4.95 / 4.95	4.90 / 4.95	-68	2.57 / 2.60	2.52 / 2.57	2.52 / 2.42	-114	2.22 / 2.25	1.67 / 1.70	2.25 / 2.27
-24	4.82 / 4.82	4.85 / 4.85	4.80 / 4.80	-70	2.47 / 2.42	2.42 / 2.40	2.45 / 2.35	-116	2.22 / 2.22	1.70 / 1.70	2.25 / 2.30
-26	4.72 / 4.77	4.75 / 4.80	4.70 / 4.70	-72	2.40 / 2.32	2.32 / 2.35	2.30 / 2.32	-118	2.22 / 2.25	1.67 / 1.67	2.25 / 2.27
-28	4.62 / 4.70	4.65 / 4.72	4.60 / 4.65	-74	2.30 / 2.30	2.25 / 2.27	2.30 / 2.25	-120	2.22 / 2.25	1.67 / 1.67	2.25 / 2.27
-30	4.55 / 4.52	4.57 / 4.55	4.52 / 4.57	-76	2.22 / 2.22	2.17 / 2.15	2.27 / 2.27	-122			
-32	4.45 / 4.47	4.47 / 4.52	4.45 / 4.42	-78	2.22 / 2.22	2.07 / 2.02	2.27 / 2.27	-124			
-34	4.37 / 4.47	4.40 / 4.47	4.35 / 4.35	-80	2.22 / 2.22	1.95 / 1.87	2.27 / 2.27	-126			
-36	4.30 / 4.35	4.32 / 4.35	4.27 / 4.32	-82	2.22 / 2.25	1.87 / 1.82	2.27 / 2.27	-128			
-38	4.22 / 4.22	4.25 / 4.22	4.20 / 4.27	-84	2.22 / 2.25	1.75 / 1.70	2.27 / 2.27	-130			
-40	4.12 / 4.20	4.15 / 4.15	4.10 / 4.10	-86	2.22 / 2.25	1.72 / 1.72	2.27 / 2.30	-132			
-42	4.02 / 4.05	4.02 / 4.02	3.97 / 4.00	-88	2.22 / 2.25	1.72 / 1.72	2.25 / 2.27	Noise	2.05 / 2.07	1.67 / 1.67	2.17 / 2.17
-44	3.85 / 3.95	3.87 / 3.92	3.82 / 3.80	-90	2.22 / 2.25	1.70 / 1.70	2.25 / 2.27				

IMP J 2dB CALIBRATION

Channel IEF 8 (100Hz) Attenuator in dB Below .1 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 202 Room

Cold 195 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.95 / 5.00	4.97 / 5.02	4.92 / 4.97	-46	3.42 / 3.47	3.45 / 3.47	3.42 / 3.47	-92	1.32 / 1.17	1.20 / 1.17	1.32 / 1.22
-2	4.95 / 5.02	4.97 / 5.02	4.92 / 5.00	-48	3.35 / 3.40	3.35 / 3.40	3.32 / 3.37	-94	1.22 / 1.07	1.15 / 1.15	1.40 / 1.17
-4	4.95 / 5.00	4.97 / 5.02	4.92 / 4.97	-50	3.27 / 3.32	3.27 / 3.32	3.25 / 3.30	-96	1.07 / 1.07	1.10 / 1.07	1.17 / 1.10
-6	4.95 / 5.00	4.97 / 5.02	4.92 / 4.97	-52	3.20 / 3.22	3.20 / 3.25	3.17 / 3.22	-98	1.02 / .95	1.05 / 1.00	1.15 / 1.10
-8	4.95 / 5.02	4.95 / 5.02	4.92 / 4.97	-54	3.10 / 3.15	3.12 / 3.15	3.10 / 3.12	-100	1.15 / .92	1.00 / .97	1.15 / 1.10
-10	4.95 / 5.02	4.97 / 5.00	4.92 / 4.97	-56	3.02 / 3.07	3.02 / 3.07	3.00 / 3.02	-102	1.12 / .95	.97 / .92	1.25 / 1.12
-12	4.95 / 5.00	4.95 / 5.00	4.92 / 4.97	-58	2.90 / 2.92	2.92 / 2.95	2.90 / 2.95	-104	1.20 / .95	.95 / .92	1.32 / 1.10
-14	4.92 / 5.00	4.95 / 5.00	4.90 / 4.97	-60	2.75 / 2.77	2.75 / 2.80	2.77 / 2.80	-106	1.00 / .92	.92 / .87	1.15 / 1.12
-16	4.80 / 4.95	4.90 / 4.97	4.87 / 4.95	-62	2.60 / 2.65	2.62 / 2.65	2.62 / 2.65	-108	.95 / .92	.92 / .87	1.12 / 1.12
-18	4.82 / 4.87	4.85 / 4.90	4.82 / 4.87	-64	2.50 / 2.52	2.50 / 2.55	2.50 / 2.52	-110	1.25 / .97	.87 / .87	1.30 / 1.15
-20	4.72 / 4.80	4.75 / 4.80	4.72 / 4.80	-66	2.40 / 2.42	2.40 / 2.45	2.40 / 2.42	-112	1.22 / .97	.90 / .87	1.35 / 1.10
-22	4.62 / 4.70	4.65 / 4.70	4.62 / 4.67	-68	2.30 / 2.35	2.32 / 2.35	2.30 / 2.32	-114	1.20 / .95	.87 / .85	1.42 / 1.12
-24	4.55 / 4.60	4.57 / 4.62	4.55 / 4.57	-70	2.22 / 2.25	2.22 / 2.27	2.22 / 2.22	-116	1.00 / .95	.87 / .85	1.12 / 1.12
-26	4.45 / 4.52	4.47 / 4.52	4.45 / 4.52	-72	2.15 / 2.17	2.15 / 2.20	2.15 / 2.15	-118	1.00 / .95	.87 / .85	1.15 / 1.12
-28	4.37 / 4.42	4.40 / 4.45	4.37 / 4.45	-74	2.07 / 2.07	2.07 / 2.10	2.05 / 2.10	-120	.95 / .95	.87 / .85	1.12 / 1.12
-30	4.30 / 4.35	4.32 / 4.37	4.30 / 4.32	-76	1.97 / 2.00	2.00 / 2.02	1.97 / 2.00	-122			
-32	4.22 / 4.27	4.25 / 4.27	4.22 / 4.27	-78	1.87 / 1.90	1.90 / 1.90	1.87 / 1.87	-124			
-34	4.15 / 4.22	4.17 / 4.20	4.15 / 4.20	-80	1.77 / 1.75	1.75 / 1.77	1.80 / 1.75	-126			
-36	4.05 / 4.10	4.07 / 4.12	4.05 / 4.10	-82	1.62 / 1.60	1.62 / 1.62	1.65 / 1.65	-128			
-38	3.95 / 4.00	3.95 / 4.00	3.95 / 4.00	-84	1.55 / 1.47	1.50 / 1.50	1.52 / 1.50	-130			
-40	3.77 / 3.82	3.80 / 3.85	3.80 / 3.85	-86	1.40 / 1.40	1.42 / 1.42	1.42 / 1.40	-132			
-42	3.65 / 3.70	3.67 / 3.72	3.65 / 3.67	-88	1.30 / 1.30	1.32 / 1.22	1.35 / 1.35	Noise	.77 / .75	.80 / .77	1.10 / 1.12
-44	3.52 / 3.57	3.55 / 3.60	3.52 / 3.57	-90	1.42 / 1.20	1.27 / 1.27	1.37 / 1.17				

IMP J 2dB CALIBRATION

Channel IEF 9 (1784 Hz) Attenuator in dB Below -1 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 202 Room

Cold 198 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.97 / 5.07	5.00 / 5.07	4.97 / 5.05	-46	3.27 / 3.32	3.25 / 3.30	3.25 / 3.30	-92	1.47 / 1.37	1.42 / 1.42	1.45 / 1.45
-2	4.97 / 5.07	5.00 / 5.07	4.97 / 5.05	-48	3.20 / 3.25	3.15 / 3.22	3.17 / 3.22	-94	1.45 / 1.45	1.42 / 1.45	1.42 / 1.45
-4	4.97 / 5.05	5.00 / 5.07	4.97 / 5.05	-50	3.12 / 3.15	3.07 / 3.12	3.10 / 3.12	-96	1.42 / 1.42	1.42 / 1.42	1.40 / 1.40
-6	4.97 / 5.05	4.97 / 5.07	4.97 / 5.05	-52	3.02 / 3.07	2.97 / 3.02	3.00 / 3.05	-98	1.40 / 1.40	1.42 / 1.45	1.40 / 1.35
-8	4.97 / 5.05	4.97 / 5.05	4.97 / 5.05	-54	2.92 / 2.95	2.82 / 2.87	2.90 / 2.95	-100	1.40 / 1.40	1.42 / 1.42	1.37 / 1.30
-10	4.95 / 5.02	4.95 / 5.02	4.95 / 5.02	-56	2.75 / 2.75	2.67 / 2.70	2.75 / 2.77	-102	1.40 / 1.40	1.42 / 1.45	1.37 / 1.30
-12	4.92 / 5.00	4.90 / 5.00	4.90 / 5.00	-58	2.62 / 2.60	2.55 / 2.57	2.60 / 2.62	-104	1.40 / 1.40	1.42 / 1.42	1.35 / 1.30
-14	4.85 / 4.95	4.82 / 4.90	4.85 / 4.92	-60	2.50 / 2.52	2.42 / 2.47	2.50 / 2.52	-106	1.40 / 1.42	1.42 / 1.42	1.35 / 1.30
-16	4.75 / 4.82	4.72 / 4.80	4.75 / 4.82	-62	2.42 / 2.45	2.35 / 2.37	2.40 / 2.35	-108	1.40 / 1.42	1.42 / 1.45	1.35 / 1.30
-18	4.65 / 4.72	4.62 / 4.70	4.65 / 4.72	-64	2.32 / 2.35	2.25 / 2.30	2.30 / 2.30	-110	1.40 / 1.40	1.42 / 1.42	1.35 / 1.25
-20	4.57 / 4.65	4.55 / 4.62	4.55 / 4.62	-66	2.25 / 2.30	2.17 / 2.22	2.22 / 2.22	-112	1.40 / 1.40	1.42 / 1.42	1.35 / 1.32
-22	4.47 / 4.55	4.45 / 4.52	4.47 / 4.55	-68	2.20 / 2.15	2.10 / 2.12	2.17 / 2.20	-114	1.40 / 1.42	1.42 / 1.45	1.35 / 1.35
-24	4.40 / 4.47	4.37 / 4.45	4.40 / 4.45	-70	2.12 / 2.15	2.00 / 2.02	2.10 / 2.00	-116	1.40 / 1.42	1.42 / 1.45	1.35 / 1.35
-26	4.32 / 4.40	4.30 / 4.37	4.30 / 4.37	-72	2.05 / 2.10	1.90 / 1.92	2.05 / 2.02	-118	1.42 / 1.45	1.42 / 1.45	1.32 / 1.32
-28	4.25 / 4.32	4.22 / 4.30	4.22 / 4.30	-74	2.00 / 1.95	1.77 / 1.77	1.97 / 1.97	-120	1.42 / 1.40	1.42 / 1.42	1.32 / 1.30
-30	4.17 / 4.22	4.12 / 4.20	4.15 / 4.22	-76	1.92 / 1.95	1.67 / 1.62	1.90 / 1.90	-122			
-32	4.07 / 4.15	4.02 / 4.10	4.05 / 4.12	-78	1.85 / 1.87	1.55 / 1.52	1.85 / 1.85	-124			
-34	3.95 / 4.02	3.87 / 3.95	3.95 / 4.00	-80	1.77 / 1.80	1.50 / 1.50	1.77 / 1.75	-126			
-36	3.80 / 3.85	3.72 / 3.80	3.77 / 3.85	-82	1.67 / 1.25	1.47 / 1.50	1.67 / 1.70	-128			
-38	3.65 / 3.70	3.60 / 3.67	3.65 / 3.70	-84	1.62 / 1.35	1.45 / 1.47	1.60 / 1.60	-130			
-40	3.55 / 3.60	3.50 / 3.55	3.52 / 3.57	-86	1.55 / 1.51	1.45 / 1.47	1.55 / 1.55	-132			
-42	3.45 / 3.50	3.40 / 3.47	3.42 / 3.47	-88	1.52 / 1.50	1.42 / 1.42	1.50 / 1.47	Noise	1.42 / 1.45	1.30 / 1.30	1.42 / 1.42
-44	3.35 / 3.40	3.32 / 3.37	3.32 / 3.37	-90	1.47 / 1.45	1.42 / 1.45	1.47 / 1.47				

IMP J 2dB CALIBRATION

Channel IEF 10 (311 HZ) Attenuator in dB Below .1 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 202 Room

Cold 198 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.92 / 5.00	4.95 / 5.02	4.92 / 5.00	-46	2.97 / 3.05	3.00 / 3.05	2.97 / 3.02	-92	1.15 / 1.15	1.25 / 1.25	1.12 / 1.10
-2	4.92 / 5.00	4.95 / 5.02	4.92 / 5.00	-48	2.87 / 2.90	2.87 / 2.92	2.87 / 2.92	-94	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-4	4.90 / 5.00	4.92 / 5.00	4.90 / 5.00	-50	2.70 / 2.75	2.70 / 2.75	2.72 / 2.75	-96	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-6	4.87 / 4.95	4.90 / 4.97	4.87 / 4.95	-52	2.57 / 2.60	2.57 / 2.62	2.57 / 2.60	-98	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-8	4.82 / 4.90	4.82 / 4.92	4.82 / 4.90	-54	2.45 / 2.50	2.45 / 2.50	2.45 / 2.50	-100	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-10	4.72 / 4.80	4.75 / 4.82	4.72 / 4.80	-56	2.35 / 2.40	2.37 / 2.40	2.35 / 2.37	-102	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-12	4.62 / 4.72	4.65 / 4.72	4.62 / 4.70	-58	2.27 / 2.30	2.27 / 2.30	2.25 / 2.30	-104	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-14	4.52 / 4.60	4.55 / 4.62	4.55 / 4.62	-60	2.20 / 2.22	2.20 / 2.22	2.17 / 2.22	-106	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-16	4.45 / 4.52	4.45 / 4.52	4.45 / 4.52	-62	2.10 / 2.15	2.12 / 2.15	2.10 / 2.12	-108	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-18	4.35 / 4.45	4.37 / 4.45	4.37 / 4.45	-64	2.02 / 2.05	2.02 / 2.05	2.02 / 2.05	-110	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-20	4.30 / 4.35	4.30 / 4.37	4.30 / 4.37	-66	1.92 / 1.95	1.92 / 1.95	1.92 / 1.95	-112	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-22	4.22 / 4.27	4.22 / 4.30	4.22 / 4.30	-68	1.80 / 1.82	1.80 / 1.82	1.82 / 1.85	-114	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-24	4.12 / 4.20	4.15 / 4.22	4.15 / 4.20	-70	1.65 / 1.65	1.67 / 1.70	1.70 / 1.72	-116	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-26	4.05 / 4.10	4.05 / 4.12	4.05 / 4.12	-72	1.52 / 1.52	1.55 / 1.55	1.57 / 1.57	-118	1.12 / 1.15	1.25 / 1.25	1.10 / 1.12
-28	3.92 / 3.97	3.92 / 4.00	3.95 / 4.00	-74	1.42 / 1.42	1.45 / 1.42	1.45 / 1.45	-120	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12
-30	3.75 / 3.82	3.77 / 3.82	3.77 / 3.85	-76	1.32 / 1.30	1.35 / 1.30	1.35 / 1.37	-122			
-32	3.62 / 3.67	3.62 / 3.70	3.62 / 3.70	-78	1.22 / 1.22	1.27 / 1.25	1.27 / 1.27	-124			
-34	3.50 / 3.57	3.52 / 3.57	3.50 / 3.57	-80	1.15 / 1.15	1.27 / 1.27	1.20 / 1.15	-126			
-36	3.40 / 3.47	3.42 / 3.47	3.40 / 3.47	-82	1.15 / 1.17	1.27 / 1.25	1.15 / 1.12	-128			
-38	3.32 / 5.37	3.32 / 3.40	3.32 / 3.37	-84	1.15 / 1.15	1.25 / 1.25	1.12 / 1.12	-130			
-40	3.25 / 3.30	3.25 / 3.30	3.22 / 3.30	-86	1.15 / 1.12	1.25 / 1.25	1.12 / 1.12	-132			
-42	3.17 / 3.22	3.17 / 3.22	3.15 / 3.20	-88	1.15 / 1.12	1.25 / 1.25	1.12 / 1.12	Noise	1.22 / 1.22	1.17 / 1.20	1.25 / 1.25
-44	3.07 / 3.12	3.10 / 3.15	3.07 / 3.12	-90	1.12 / 1.15	1.25 / 1.25	1.12 / 1.12				

IMP J 2dB CALIBRATION

Channel IEF-11 (560 Hz) Attenuator in dB Below .316 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 202 Room

Cold 198 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.90 / 5.00	4.92 / 5.00	4.92 / 5.00	-46	3.22 / 3.30	3.25 / 3.30	3.22 / 3.30	-92	.77 / .77	.77 / .77	.75 / .75
-2	4.90 / 5.00	4.92 / 5.00	4.90 / 5.00	-48	3.15 / 3.22	3.17 / 3.22	3.15 / 3.22	-94	.67 / .67	.67 / .65	.65 / .62
-4	4.90 / 4.97	4.92 / 5.00	4.90 / 5.00	-50	3.07 / 3.12	3.07 / 3.15	3.07 / 3.12	-96	.60 / .60	.60 / .60	.57 / .55
-6	4.90 / 4.97	4.92 / 5.00	4.90 / 5.00	-52	2.97 / 3.02	3.00 / 3.05	2.97 / 3.05	-98	.57 / .55	.55 / .52	.55 / .52
-8	4.90 / 4.97	4.92 / 5.00	4.90 / 5.00	-54	2.75 / 2.85	2.87 / 2.92	2.87 / 2.92	-100	.55 / .52	.52 / .52	.52 / .50
-10	4.87 / 4.97	4.90 / 5.00	4.90 / 4.97	-56	2.60 / 2.70	2.70 / 2.75	2.72 / 2.77	-102	.52 / .52	.52 / .50	.52 / .50
-12	4.85 / 4.95	4.87 / 4.97	4.87 / 4.95	-58	2.55 / 2.60	2.55 / 2.62	2.57 / 2.62	-104	.55 / .52	.52 / .50	.52 / .50
-14	4.80 / 4.87	4.82 / 4.90	4.82 / 4.90	-60	2.45 / 2.50	2.45 / 2.50	2.45 / 2.50	-106	.55 / .55	.52 / .50	.55 / .52
-16	4.70 / 4.77	4.72 / 4.80	4.72 / 4.82	-62	2.35 / 2.40	2.35 / 2.40	2.35 / 2.37	-108	.55 / .52	.52 / .52	.55 / .52
-18	4.60 / 4.70	4.62 / 4.72	4.62 / 4.72	-64	2.25 / 2.30	2.27 / 2.30	2.25 / 2.30	-110	.57 / .55	.55 / .52	.55 / .52
-20	4.52 / 4.60	4.55 / 4.62	4.55 / 4.62	-66	2.17 / 2.22	2.17 / 2.22	2.17 / 2.20	-112	.57 / .55	.55 / .52	.57 / .55
-22	4.42 / 4.52	4.45 / 4.52	4.45 / 4.55	-68	2.10 / 2.12	2.10 / 2.15	2.07 / 2.12	-114	.57 / .57	.55 / .55	.57 / .55
-24	4.35 / 4.42	4.37 / 4.45	4.37 / 4.45	-70	2.00 / 2.05	2.02 / 2.05	2.00 / 2.05	-116	.57 / .57	.57 / .55	.57 / .57
-26	4.27 / 4.35	4.30 / 4.37	4.30 / 4.37	-72	1.90 / 1.95	1.92 / 1.95	1.90 / 1.95	-118	.57 / .57	.57 / .55	.57 / .55
-28	4.20 / 4.27	4.22 / 4.30	4.22 / 4.30	-74	1.77 / 1.80	1.77 / 1.82	1.80 / 1.82	-120	.57 / .57	.57 / .55	.57 / .55
-30	4.12 / 4.20	4.12 / 4.22	4.15 / 4.22	-76	1.60 / 1.65	1.62 / 1.65	1.62 / 1.67	-122			
-32	4.02 / 4.10	4.05 / 4.12	4.05 / 4.12	-78	1.47 / 1.50	1.47 / 1.50	1.47 / 1.50	-124			
-34	3.90 / 3.97	3.92 / 4.00	3.95 / 4.02	-80	1.35 / 1.37	1.37 / 1.40	1.35 / 1.37	-126			
-36	3.75 / 3.80	3.75 / 3.82	3.77 / 3.85	-82	1.25 / 1.27	1.27 / 1.30	1.25 / 1.27	-128			
-38	3.60 / 3.67	3.62 / 3.70	3.65 / 3.70	-84	1.17 / 1.20	1.17 / 1.20	1.15 / 1.17	-130			
-40	3.50 / 3.57	3.50 / 3.57	3.52 / 3.57	-86	1.07 / 1.10	1.10 / 1.10	1.07 / 1.07	-132			
-42	3.40 / 3.47	3.42 / 3.47	3.40 / 3.47	-88	.97 / 1.00	1.00 / 1.00	.77 / .77	Noise	.70 / .70	.60 / .60	.57 / .55
-44	3.32 / 3.37	3.32 / 3.40	3.32 / 3.37	-90	.87 / .87	.90 / .90	.87 / .85				

IMP J 2dB CALIBRATION

Channel IEF 12 (1KHz) Attenuator in dB Below -316 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 203 Room

Cold 198 Cold -20°C

PEAK / AVE

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.92 / 5.00	4.92 / 5.02	4.90 / 5.00	-46	3.15 / 3.20	3.15 / 3.20	3.12 / 3.17	-92	.82 / .82	.82 / .80	.82 / .85
-2	4.92 / 5.00	4.92 / 5.02	4.90 / 4.97	-48	3.05 / 3.10	3.05 / 3.12	3.02 / 3.10	-94	.72 / .72	.72 / .70	.75 / .75
-4	4.80 / 5.00	4.92 / 5.02	4.90 / 4.97	-50	2.92 / 2.97	2.92 / 3.00	2.72 / 2.97	-96	.65 / .65	.62 / .62	.67 / .65
-6	4.90 / 5.06	4.92 / 5.00	4.87 / 4.97	-52	2.77 / 2.82	2.77 / 2.82	2.75 / 2.80	-98	.57 / .57	.57 / .57	.60 / .57
-8	4.90 / 4.97	4.90 / 5.00	4.87 / 4.95	-54	2.62 / 2.67	2.62 / 2.67	2.60 / 2.65	-100	.52 / .50	.52 / .50	.55 / .52
-10	4.85 / 4.95	4.87 / 4.95	4.85 / 4.92	-56	2.50 / 2.55	2.50 / 2.55	2.50 / 2.52	-102	.47 / .47	.47 / .45	.50 / .45
-12	4.75 / 4.85	4.77 / 4.87	4.75 / 4.85	-58	2.40 / 2.45	2.40 / 2.45	2.37 / 2.42	-104	.45 / .42	.45 / .45	.45 / .42
-14	4.67 / 4.85	4.70 / 4.77	4.67 / 4.75	-60	2.32 / 2.37	2.32 / 2.37	2.30 / 2.35	-106	.42 / .42	.42 / .40	.42 / .40
-16	4.60 / 4.67	4.60 / 4.70	4.60 / 4.67	-62	2.25 / 2.27	2.25 / 2.27	2.20 / 2.25	-108	.40 / .37	.40 / .37	.42 / .40
-18	4.52 / 4.60	4.52 / 4.62	4.52 / 4.60	-64	2.15 / 2.20	2.17 / 2.20	2.12 / 2.17	-110	.40 / .37	.37 / .35	.40 / .35
-20	4.42 / 4.52	4.45 / 4.52	4.45 / 4.52	-66	2.07 / 2.12	2.07 / 2.12	2.05 / 2.10	-112	.37 / .35	.37 / .35	.37 / .37
-22	4.35 / 4.45	4.37 / 4.45	4.35 / 4.45	-68	1.97 / 2.02	2.00 / 2.02	1.97 / 2.00	-114	.37 / .35	.37 / .35	.37 / .35
-24	4.27 / 4.37	4.30 / 4.37	4.27 / 4.37	-70	1.87 / 1.90	1.87 / 1.90	1.85 / 1.90	-116	.37 / .32	.35 / .32	.35 / .32
-26	4.20 / 4.27	4.22 / 4.30	4.20 / 4.27	-72	1.70 / 1.75	1.72 / 1.75	1.70 / 1.75	-118	.35 / .35	.35 / .32	.35 / .32
-28	4.10 / 4.20	4.12 / 4.20	4.12 / 4.20	-74	1.57 / 1.60	1.57 / 1.60	1.57 / 1.60	-120	.35 / .32	.32 / .32	.35 / .32
-30	3.97 / 4.05	4.00 / 4.07	4.00 / 4.07	-76	1.45 / 1.47	1.45 / 1.47	1.45 / 1.47	-122			
-32	3.82 / 3.90	3.82 / 3.90	3.82 / 3.90	-78	1.35 / 1.37	1.35 / 1.37	1.35 / 1.37	-124			
-34	3.67 / 3.75	3.70 / 3.77	3.67 / 3.75	-80	1.27 / 1.30	1.27 / 1.30	1.25 / 1.27	-126			
-36	3.57 / 3.65	3.57 / 3.65	3.57 / 3.62	-82	1.20 / 1.22	1.20 / 1.22	1.17 / 1.20	-128			
-38	3.47 / 3.55	3.47 / 3.55	3.47 / 3.52	-84	1.12 / 1.15	1.12 / 1.15	1.10 / 1.12	-130			
-40	3.40 / 3.45	3.40 / 3.45	3.37 / 3.42	-86	1.05 / 1.07	1.05 / 1.07	1.05 / 1.05	-132			
-42	3.30 / 3.37	3.32 / 3.37	3.27 / 3.35	-88	1.00 / 1.00	1.00 / 1.00	.97 / .97	Noise	.27 / .25	.30 / .27	.20 / .17
-44	3.22 / 3.30	3.22 / 3.30	3.20 / 3.27	-90	.90 / .92	.90 / .90	.90 / .90				

IMP J 2dB CALIBRATION

Channel JFF 13 (178KHz) Attenuator in dB Below 1 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 203 Room

Cold 198 Cold -20°C

Peak / Ave

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.62 / 4.72	4.65 / 4.75	4.65 / 4.72	-46	3.27 / 3.32	3.27 / 3.35	3.27 / 3.35	-92	.82 / .85	.82 / .82	.85 / .85
-2	4.62 / 4.70	4.65 / 4.72	4.65 / 4.72	-48	3.17 / 3.25	3.20 / 3.27	3.20 / 3.27	-94	.65 / .65	.67 / .67	.72 / .70
-4	4.62 / 4.70	4.65 / 4.72	4.65 / 4.72	-50	3.10 / 3.17	3.12 / 3.17	3.12 / 3.17	-96	.52 / .52	.52 / .52	.55 / .55
-6	4.62 / 4.70	4.65 / 4.72	4.65 / 4.72	-52	3.00 / 3.07	3.02 / 3.10	3.02 / 3.10	-98	.40 / .40	.40 / .40	.35 / .30
-8	4.62 / 4.70	4.65 / 4.72	4.65 / 4.72	-54	2.87 / 2.95	2.90 / 2.97	2.92 / 2.97	-100	.32 / .32	.32 / .32	.35 / .32
-10	4.62 / 4.70	4.65 / 4.72	4.65 / 4.72	-56	2.72 / 2.77	2.75 / 2.80	2.77 / 2.82	-102	.27 / .27	.30 / .27	.27 / .27
-12	4.60 / 4.70	4.65 / 4.72	4.65 / 4.72	-58	2.57 / 2.65	2.60 / 2.65	2.62 / 2.67	-104	.25 / .22	.25 / .25	.25 / .25
-14	4.60 / 4.70	4.62 / 4.72	4.62 / 4.72	-60	2.47 / 2.52	2.47 / 2.55	2.50 / 2.55	-106	.22 / .22	.25 / .22	.25 / .22
-16	4.60 / 4.67	4.67 / 4.70	4.62 / 4.70	-62	2.37 / 2.42	2.37 / 2.42	2.37 / 2.42	-108	.25 / .22	.25 / .22	.25 / .22
-18	4.57 / 4.65	4.60 / 4.67	4.60 / 4.67	-64	2.27 / 2.32	2.30 / 2.35	2.30 / 2.35	-110	.25 / .25	.27 / .22	.25 / .25
-20	4.52 / 4.62	4.55 / 4.65	4.55 / 4.65	-66	2.20 / 2.25	2.22 / 2.25	2.20 / 2.25	-112	.25 / .25	.27 / .25	.27 / .25
-22	4.45 / 4.52	4.47 / 4.55	4.47 / 4.57	-68	2.12 / 2.17	2.12 / 2.17	2.12 / 2.17	-114	.25 / .25	.27 / .25	.27 / .25
-24	4.37 / 4.45	4.40 / 4.47	4.40 / 4.50	-70	2.02 / 2.07	2.05 / 2.10	2.05 / 2.10	-116	.27 / .25	.30 / .25	.27 / .27
-26	4.30 / 4.40	4.32 / 4.40	4.32 / 4.42	-72	1.95 / 1.97	1.95 / 2.00	1.95 / 2.00	-118	.27 / .27	.30 / .30	.27 / .27
-28	4.22 / 4.32	4.25 / 4.32	4.25 / 4.35	-74	1.82 / 1.85	1.82 / 1.87	1.85 / 1.90	-120	.27 / .27	.30 / .30	.30 / .30
-30	4.15 / 4.22	4.17 / 4.25	4.17 / 4.25	-76	1.65 / 1.70	1.67 / 1.70	1.70 / 1.75	-122			
-32	4.05 / 4.15	4.07 / 4.17	4.10 / 4.17	-78	1.50 / 1.55	1.52 / 1.55	1.55 / 1.57	-124			
-34	3.92 / 4.02	3.97 / 4.05	4.00 / 4.07	-80	1.40 / 1.42	1.40 / 1.42	1.42 / 1.45	-126			
-36	3.77 / 3.85	3.80 / 3.87	3.82 / 3.90	-82	1.30 / 1.32	1.30 / 1.32	1.30 / 1.27	-128			
-38	3.62 / 3.70	3.67 / 3.75	3.67 / 3.75	-84	1.20 / 1.22	1.22 / 1.25	1.22 / 1.25	-130			
-40	3.52 / 3.60	3.55 / 3.62	3.55 / 3.62	-86	1.12 / 1.15	1.12 / 1.15	1.12 / 1.15	-132			
-42	3.42 / 3.50	3.45 / 3.52	3.45 / 3.52	-88	1.02 / 1.05	1.05 / 1.05	1.05 / 1.07	Noise	.17 / .17	.22 / .20	.25 / .25
-44	3.35 / 3.42	3.35 / 3.42	3.35 / 3.42	-90	.95 / .95	.95 / .95	.95 / .97				

IMP J 2dB CALIBRATION

Channel 5.60 KHz SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot 130°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	505	501	510	-46	3.07	3.10	3.10	-92	.47	.47	.47
-2	5.05	507	510	-48	2.95	2.97	297	-94	.37	.37	.37
-4	5.05	501	5.10	-50	2.87	2.87	2.87	-96	.30	.32	.30
-6	505	501	5.10	-52	280	2.80	2.80	-98	.25	.25	.25
-8	5.05	507	510	-54	2.72	2.72	2.72	-100	.22	.22	.20
-10	5.05	507	510	-56	2.67	2.67	2.67	-102	.20	.20	.17
-12	505	505	510	-58	2.62	2.62	2.62	-104	.17	.17	.15
-14	505	505	510	-60	2.52	2.55	2.57	-106	.15	.15	.12
-16	502	502	507	-62	2.32	2.35	2.40	-108	.15	.15	.12
-18	487	490	495	-64	2.12	2.15	2.17	-110	.15	.15	.12
-20	4.65	467	4.72	-66	1.95	1.97	1.97	-112	.15	.12	.10
-22	4.47	4.50	455	-68	1.82	1.82	1.82	-114	.12	.12	.10
-24	435	437	4.40	-70	1.70	1.70	1.70	-116	.12	.12	.10
-26	422	425	427	-72	1.60	1.60	1.60	-118	.12	.12	.10
-28	4.15	4.15	4.17	-74	1.55	1.55	1.52	-120	.12	.12	.10
-30	407	407	4.10	-76	1.47	1.47	1.47	-122			
-32	4.00	402	402	-78	1.42	1.42	1.42	-124			
-34	395	397	397	-80	1.37	1.37	1.37	-126			
-36	392	392	395	-82	1.30	1.32	1.32	-128			
-38	385	387	390	-84	1.07	1.12	1.15	-130			
-40	3.65	367	3.70	-86	.87	.90	.90	-132			
-42	342	345	345	-88	.70	.72	.72	Noise	.12	.12	.10
-44	322	325	325	-90	.57	.57	.57				

IMP J 2dB CALIBRATION

Channel 10 KHZ SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot 30°C

Room 203 Room

Cold 179 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.05	5.01	5.13	-46	3.10	3.12	3.15	-92	.47	.50	.50
-2	5.05	5.01	5.13	-48	2.97	3.00	3.00	-94	.40	.40	.40
-4	5.05	5.01	5.10	-50	2.87	2.90	2.90	-96	.32	.32	.32
-6	5.05	5.07	5.10	-52	2.80	2.80	2.82	-98	.27	.27	.25
-8	5.05	5.07	5.10	-54	2.75	2.75	2.75	-100	.22	.22	.22
-10	5.05	5.07	5.10	-56	2.67	2.70	2.70	-102	.20	.20	.17
-12	5.05	5.07	5.10	-58	2.62	2.65	2.65	-104	.17	.17	.15
-14	5.05	5.05	5.10	-60	2.55	2.57	2.60	-106	.17	.15	.15
-16	5.02	5.05	5.10	-62	2.35	2.37	2.30	-108	.15	.15	.12
-18	4.92	4.95	5.05	-64	2.15	2.17	2.22	-110	.15	.15	.12
-20	4.70	4.72	4.80	-66	1.97	2.00	2.02	-112	.15	.12	.12
-22	4.52	4.55	4.60	-68	1.85	1.85	1.87	-114	.15	.12	.10
-24	4.37	4.40	4.45	-70	1.72	1.72	1.72	-116	.15	.12	.10
-26	4.25	4.27	4.32	-72	1.62	1.62	1.62	-118	.15	.12	.10
-28	4.17	4.17	4.20	-74	1.55	1.55	1.55	-120	.12	.12	.10
-30	4.10	4.10	4.12	-76	1.50	1.50	1.47	-122			
-32	4.02	4.02	4.05	-78	1.45	1.45	1.42	-124			
-34	3.97	3.97	4.00	-80	1.40	1.40	1.37	-126			
-36	3.92	3.92	3.95	-82	1.32	1.35	1.35	-128			
-38	3.87	3.87	3.90	-84	1.15	1.17	1.22	-130			
-40	3.70	3.72	3.80	-86	.92	.95	.97	-132			
-42	3.47	3.47	3.52	-88	.75	.75	.77	Noise	.12	.12	.10
-44	3.27	3.27	3.32	-90	.60	.60	.62				

IMP J 2dB CALIBRATION

Channel 16.5 KHz SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot +30°C

Room 203 Room

Cold 199 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.05	5.01	5.13	-46	3.17	3.17	3.17	-92	.52	.52	.52
-2	5.05	5.01	5.13	-48	3.02	3.05	3.05	-94	.42	.42	.40
-4	5.05	5.01	5.13	-50	2.92	2.92	2.92	-96	.35	.35	.32
-6	5.05	5.01	5.10	-52	2.85	2.85	2.82	-98	.30	.30	.27
-8	5.05	5.01	5.10	-54	2.77	2.77	2.75	-100	.25	.25	.22
-10	5.05	5.01	5.10	-56	2.70	2.72	2.70	-102	.22	.22	.17
-12	5.05	5.01	5.10	-58	2.65	2.65	2.65	-104	.20	.17	.15
-14	5.05	5.05	5.10	-60	2.60	2.60	2.60	-106	.17	.17	.15
-16	5.02	5.05	5.10	-62	2.45	2.47	2.55	-108	.15	.15	.12
-18	5.00	5.02	5.07	-64	2.25	2.25	2.30	-110	.15	.15	.12
-20	4.80	4.82	4.87	-66	2.05	2.07	2.01	-112	.15	.15	.12
-22	4.60	4.62	4.67	-68	1.90	1.90	1.90	-114	.15	.12	.10
-24	4.45	4.45	4.50	-70	1.77	1.77	1.75	-116	.15	.12	.10
-26	4.30	4.32	4.35	-72	1.65	1.67	1.65	-118	.15	.12	.10
-28	4.20	4.22	4.25	-74	1.57	1.57	1.57	-120	.15	.12	.10
-30	4.12	4.12	4.15	-76	1.50	1.52	1.50	-122			
-32	4.05	4.05	4.07	-78	1.45	1.45	1.45	-124			
-34	4.00	4.00	4.02	-80	1.40	1.40	1.40	-126			
-36	3.95	3.95	3.97	-82	1.35	1.37	1.35	-128			
-38	3.90	3.90	3.92	-84	1.25	1.27	1.27	-130			
-40	3.80	3.82	3.85	-86	1.00	1.02	1.02	-132			
-42	3.57	3.57	3.60	-88	.80	.82	.80	Noise	.15	.12	.10
-44	3.35	3.35	3.37	-90	.65	.67	.65				

IMP J 2dB CALIBRATION

Channel 22 KHz SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot +30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.05	5.07	5.13	-46	3.27	3.30	3.32	-92	.62	.62	.62
-2	5.05	5.07	5.13	-48	3.12	3.12	3.15	-94	.50	.50	.47
-4	5.05	5.07	5.13	-50	3.00	3.00	3.00	-96	.40	.40	.37
-6	5.05	5.07	5.13	-52	2.90	2.90	2.90	-98	.32	.32	.30
-8	5.05	5.07	5.10	-54	2.82	2.82	2.82	-100	.27	.27	.25
-10	5.05	5.07	5.10	-56	2.75	2.75	2.75	-102	.25	.22	.22
-12	5.05	5.07	5.10	-58	2.70	2.70	2.70	-104	.22	.20	.17
-14	5.05	5.07	5.10	-60	2.65	2.65	2.65	-106	.20	.17	.15
-16	5.05	5.05	5.10	-62	2.57	2.57	2.60	-108	.17	.17	.15
-18	5.02	5.05	5.10	-64	2.37	2.40	2.50	-110	.17	.15	.12
-20	4.95	4.97	5.02	-66	2.17	2.20	2.22	-112	.15	.15	.12
-22	4.72	4.75	4.80	-68	2.00	2.00	2.02	-114	.15	.15	.12
-24	4.55	4.55	4.60	-70	1.85	1.85	1.85	-116	.15	.12	.12
-26	4.40	4.40	4.45	-72	1.72	1.72	1.72	-118	.15	.12	.12
-28	4.27	4.27	4.30	-74	1.62	1.62	1.62	-120	.15	.12	.12
-30	4.17	4.17	4.20	-76	1.55	1.55	1.55	-122			
-32	4.10	4.10	4.12	-78	1.50	1.50	1.47	-124			
-34	4.02	4.05	4.05	-80	1.45	1.45	1.42	-126			
-36	3.97	3.97	4.00	-82	1.40	1.40	1.37	-128			
-38	3.92	3.95	3.95	-84	1.35	1.35	1.32	-130			
-40	3.87	3.90	3.90	-86	1.20	1.17	1.22	-132			
-42	3.72	3.75	3.80	-88	.95	.95	.77	Noise	.15	.12	.10
-44	3.47	3.50	3.52	-90	.77	.77	.77				

IMP J 2dB CALIBRATION

Channel 31 KHZ SPF Attenuator in dB Below 10 V rms

Dates: Hot 193 Temperature: Hot +30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.05	5.07	5.13	-46	3.37	3.40	3.37	-92	.70	.70	.65
-2	5.05	5.07	5.13	-48	3.20	3.20	3.17	-94	.55	.55	.52
-4	5.05	5.07	5.13	-50	3.05	3.07	3.05	-96	.45	.45	.40
-6	5.05	5.07	5.10	-52	2.95	2.95	2.92	-98	.37	.37	.32
-8	5.05	5.07	5.10	-54	2.85	2.85	2.82	-100	.32	.30	.27
-10	5.05	5.07	5.10	-56	2.77	2.77	2.77	-102	.27	.25	.22
-12	5.05	5.07	5.10	-58	2.72	2.72	2.70	-104	.22	.22	.20
-14	5.05	5.07	5.10	-60	2.67	2.67	2.65	-106	.20	.20	.17
-16	5.05	5.05	5.10	-62	2.62	2.62	2.62	-108	.20	.17	.15
-18	5.05	5.05	5.10	-64	2.50	2.52	2.55	-110	.17	.17	.15
-20	5.02	5.02	5.07	-66	2.27	2.30	2.30	-112	.17	.15	.12
-22	4.85	4.87	4.90	-68	2.10	2.10	2.07	-114	.17	.15	.12
-24	4.65	4.65	4.67	-70	1.92	1.92	1.90	-116	.17	.15	.12
-26	4.47	4.47	4.50	-72	1.80	1.80	1.75	-118	.17	.15	.12
-28	4.32	4.35	4.35	-74	1.70	1.67	1.65	-120	.17	.15	.12
-30	4.22	4.22	4.25	-76	1.60	1.60	1.57	-122			
-32	4.12	4.15	4.15	-78	1.52	1.52	1.50	-124			
-34	4.07	4.07	4.07	-80	1.47	1.47	1.45	-126			
-36	4.00	4.02	4.02	-82	1.42	1.42	1.40	-128			
-38	3.95	3.97	3.97	-84	1.37	1.37	1.35	-130			
-40	3.90	3.92	3.92	-86	1.30	1.30	1.27	-132			
-42	3.82	3.85	3.85	-88	1.05	1.07	1.02	Noise	.17	.15	.12
-44	3.60	3.62	3.60	-90	.85	.87	.82				

IMP J 2dB CALIBRATION

Channel 56 KHz SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot +30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.07	5.07	5.13	-46	3.52	3.55	3.55	-92	.80	.80	.80
-2	5.07	5.07	5.13	-48	3.32	3.32	3.32	-94	.65	.65	.62
-4	5.07	5.07	5.13	-50	3.15	3.17	3.15	-96	.52	.52	.50
-6	5.07	5.07	5.13	-52	3.02	3.02	3.02	-98	.45	.42	.42
-8	5.05	5.07	5.13	-54	2.92	2.92	2.90	-100	.37	.35	.35
-10	5.05	5.07	5.10	-56	2.82	2.82	2.82	-102	.32	.30	.30
-12	5.05	5.07	5.10	-58	2.75	2.77	2.75	-104	.27	.25	.25
-14	5.05	5.07	5.10	-60	2.70	2.70	2.70	-106	.27	.22	.22
-16	5.05	5.07	5.10	-62	2.65	2.65	2.65	-108	.25	.20	.20
-18	5.05	5.05	5.10	-64	2.60	2.60	2.60	-110	.22	.20	.20
-20	5.02	5.05	5.10	-66	2.42	2.45	2.50	-112	.22	.17	.20
-22	5.00	5.00	5.05	-68	2.22	2.22	2.25	-114	.22	.17	.17
-24	4.80	4.80	4.82	-70	2.02	2.05	2.20	-116	.22	.17	.17
-26	4.60	4.60	4.62	-72	1.87	1.87	1.87	-118	.22	.17	.17
-28	4.42	4.45	4.45	-74	1.75	1.75	1.75	-120	.22	.17	.17
-30	4.30	4.30	4.32	-76	1.65	1.65	1.62	-122			
-32	4.20	4.20	4.22	-78	1.57	1.57	1.55	-124			
-34	4.10	4.12	4.12	-80	1.50	1.50	1.47	-126			
-36	4.05	4.05	4.07	-82	1.45	1.45	1.42	-128			
-38	4.00	4.00	4.00	-84	1.40	1.40	1.37	-130			
-40	3.95	3.95	3.95	-86	1.35	1.35	1.35	-132			
-42	3.90	3.90	3.92	-88	1.22	1.25	1.25	Noise	.22	.17	.17
-44	3.80	3.80	3.82	-90	1.00	1.00	1.00				

IMP J 2dB CALIBRATION

Channel 100 KHZ SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot 30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.07	5.07	5.10	-46	3.62	3.62	3.62	-92	.85	.82	.82
-2	5.07	5.07	5.10	-48	3.40	3.40	3.37	-94	.70	.67	.67
-4	5.07	5.07	5.10	-50	3.20	3.20	3.20	-96	.57	.52	.52
-6	5.07	5.07	5.10	-52	3.05	3.05	3.05	-98	.47	.45	.42
-8	5.07	5.07	5.10	-54	2.95	2.95	2.92	-100	.40	.40	.37
-10	5.07	5.07	5.10	-56	2.85	2.85	2.85	-102	.35	.35	.30
-12	5.05	5.07	5.10	-58	2.77	2.77	2.77	-104	.30	.30	.27
-14	5.05	5.07	5.10	-60	2.72	2.72	2.70	-106	.27	.27	.25
-16	5.05	5.07	5.10	-62	2.67	2.65	2.65	-108	.27	.27	.22
-18	5.05	5.07	5.10	-64	2.60	2.60	2.60	-110	.25	.25	.22
-20	5.05	5.05	5.10	-66	2.47	2.50	2.55	-112	.25	.25	.20
-22	5.02	5.02	5.07	-68	2.27	2.25	2.30	-114	.25	.25	.20
-24	4.87	4.87	4.90	-70	2.07	2.05	2.07	-116	.25	.25	.20
-26	4.65	4.67	4.67	-72	1.92	1.90	1.90	-118	.25	.25	.20
-28	4.47	4.50	4.50	-74	1.77	1.75	1.77	-120	.22	.25	20
-30	4.35	4.35	4.35	-76	1.67	1.65	1.65	-122			
-32	4.22	4.22	4.25	-78	1.60	1.57	1.57	-124			
-34	4.15	4.15	4.15	-80	1.52	1.50	1.50	-126			
-36	4.07	4.07	4.07	-82	1.47	1.45	1.45	-128			
-38	4.00	4.02	4.02	-84	1.42	1.40	1.40	-130			
-40	3.95	3.97	3.97	-86	1.37	1.35	1.35	-132			
-42	3.90	3.92	3.92	-88	1.27	1.27	1.27	Noise	.22	.25	.20
-44	3.85	3.85	3.85	-90	1.05	1.02	1.05				

IMP J 2dB CALIBRATION

Channel 178 KHz SPF Attenuator in dB Below 1.0 V rms

Dates: Hot 193 Temperature: Hot +30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	5.07	5.07	5.10	-46	3.60	3.62	3.57	-92	.80	.82	.77
-2	5.07	5.07	5.10	-48	3.37	3.40	3.35	-94	.62	.67	.62
-4	5.07	5.07	5.10	-50	3.20	3.20	3.17	-96	.52	.52	.50
-6	5.07	5.07	5.10	-52	3.05	3.05	3.02	-98	.45	.45	.42
-8	5.07	5.07	5.10	-54	2.92	2.95	2.90	-100	.40	.40	.35
-10	5.07	5.07	5.10	-56	2.85	2.85	2.82	-102	.35	.35	.32
-12	5.07	5.07	5.10	-58	2.77	2.77	2.75	-104	.32	.30	.27
-14	5.05	5.07	5.10	-60	2.72	2.72	2.70	-106	.30	.27	.27
-16	5.05	5.07	5.10	-62	2.65	2.65	2.65	-108	.30	.27	.25
-18	5.05	5.07	5.10	-64	2.60	2.60	2.60	-110	.27	.25	.25
-20	5.05	5.05	5.07	-66	2.45	2.50	2.50	-112	.27	.25	.22
-22	5.02	5.02	5.05	-68	2.22	2.25	2.22	-114	.27	.25	.22
-24	4.87	4.87	4.90	-70	2.05	2.05	2.02	-116	.27	.25	.22
-26	4.65	4.67	4.67	-72	1.87	1.90	1.85	-118	.27	.25	.22
-28	4.47	4.50	4.50	-74	1.75	1.75	1.72	-120	.27	.25	.22
-30	4.32	4.35	4.35	-76	1.65	1.65	1.62	-122			
-32	4.22	4.22	4.22	-78	1.57	1.57	1.55	-124			
-34	4.12	4.15	4.15	-80	1.50	1.50	1.47	-126			
-36	4.07	4.07	4.07	-82	1.45	1.45	1.42	-128			
-38	4.00	4.02	4.02	-84	1.40	1.40	1.37	-130			
-40	3.95	3.97	3.97	-86	1.35	1.35	1.32	-132			
-42	3.90	3.92	3.92	-88	1.20	1.27	1.22	Noise	.27	.25	.22
-44	3.85	3.85	3.85	-90	.97	1.02	.97				

IMP J 2dB CALIBRATION

Channel O-1 E, WBR Attenuator in dB Below 1.0 V rm

Dates: Hot 196 Temperature: Hot 30.8°C

Room 203 Room 24.9°C

Cold 199 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.90	4.90	4.90	-46	3.00	2.97	2.97	-92	.91	.87	.97
-2	4.87	4.90	4.90	-48	2.85	2.82	2.85	-94	.91	.82	.97
-4	4.85	4.85	4.87	-50	2.70	2.67	2.67	-96	.91	.80	.97
-6	4.82	4.80	4.82	-52	2.57	2.55	2.55	-98	.91	.80	.97
-8	4.75	4.72	4.75	-54	2.47	2.45	2.45	-100	.91	.80	.97
-10	4.65	4.65	4.65	-56	2.37	2.35	2.35	-102	.91	.77	.97
-12	4.57	4.57	4.57	-58	2.27	2.27	2.25	-104	.91	.77	.97
-14	4.52	4.50	4.50	-60	2.20	2.20	2.17	-106	.91	.75	.95
-16	4.45	4.45	4.45	-62	2.12	2.12	2.10	-108	.91	.75	.95
-18	4.40	4.37	4.37	-64	2.05	2.02	2.02	-110	.91	.75	.95
-20	4.32	4.32	4.32	-66	1.92	1.92	1.90	-112			
-22	4.27	4.25	4.25	-68	1.80	1.80	1.77	-114			
-24	4.17	4.17	4.17	-70	1.65	1.65	1.62	-116			
-26	4.07	4.05	4.07	-72	1.52	1.52	1.50	-118			
-28	3.92	3.90	3.92	-74	1.40	1.40	1.37	-120			
-30	3.77	3.75	3.75	-76	1.30	1.32	1.27	-122			
-32	3.65	3.62	3.62	-78	1.22	1.25	1.17	-124			
-34	3.55	3.52	3.52	-80	1.15	1.17	1.12	-126			
-36	3.45	3.42	3.42	-82	1.10	1.10	1.05	-128			
-38	3.35	3.35	3.32	-84	1.05	1.05	1.02	-130			
-40	3.27	3.25	3.25	-86	1.02	1.00	1.00	-132			
-42	3.20	3.17	3.17	-88	1.00	.95	.97	Noise	.97	.75	.97
-44	3.12	3.10	3.07	-90	1.00	.87	.97				

IMP J 2dB CALIBRATION

Channel O-1 Ey WBR Attenuator in dB Below 1.0 V rms

Dates: Hot 196 Temperature: Hot 30.8°C

Room 203 Room 29.9°C

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.90	4.90	4.90	-46	3.00	3.00	3.00	-92	.52	.77	.50
-2	4.87	4.90	4.90	-48	2.85	2.85	2.85	-94	.47	.75	.47
-4	4.85	4.85	4.87	-50	2.70	2.70	2.70	-96	.42	.75	.40
-6	4.82	4.82	4.82	-52	2.57	2.55	2.55	-98	.40	.75	.40
-8	4.75	4.75	4.75	-54	2.47	2.45	2.45	-100	.35	.75	.37
-10	4.65	4.65	4.65	-56	2.37	2.35	2.35	-102	.35	.75	.35
-12	4.57	4.57	4.57	-58	2.27	2.27	2.27	-104	.35	.75	.35
-14	4.52	4.50	4.50	-60	2.20	2.20	2.17	-106	.35	.75	.32
-16	4.45	4.45	4.45	-62	2.12	2.12	2.10	-108	.32	.72	.32
-18	4.40	4.37	4.37	-64	2.02	2.02	2.02	-110	.32	.72	.32
-20	4.32	4.32	4.32	-66	1.92	1.92	1.92	-112			
-22	4.27	4.25	4.25	-68	1.80	1.77	1.77	-114			
-24	4.17	4.17	4.17	-70	1.62	1.62	1.62	-116			
-26	4.07	4.07	4.07	-72	1.50	1.50	1.47	-118			
-28	3.92	3.92	3.92	-74	1.37	1.37	1.37	-120			
-30	3.77	3.75	3.77	-76	1.30	1.30	1.27	-122			
-32	3.65	3.62	3.62	-78	1.20	1.20	1.17	-124			
-34	3.55	3.52	3.52	-80	1.12	1.12	1.10	-126			
-36	3.45	3.42	3.42	-82	1.05	1.05	1.02	-128			
-38	3.35	3.35	3.35	-84	.95	.95	.92	-130			
-40	3.27	3.27	3.25	-86	.85	.87	.82	-132			
-42	3.20	3.20	3.17	-88	.72	.85	.70	Noise	.32	.67	.30
-44	3.10	3.10	3.10	-90	.62	.80	.60				

IMP J 2dB CALIBRATION

Channel 0-1 KHz Bx WBR Attenuator in dB Below 1.0 V rms

Dates: Hot 197 Temperature: Hot +30°C

Room 203 Room

Cold 194 Cold -20°C

TTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.55	4.55	457	-46	3.27	3.27	3.30	-92	1.50	1.55	1.60
2	4.55	4.55	4.57	-48	3.20	3.20	3.22	-94	1.50	155	1.60
4	4.55	4.55	457	-50	3.10	3.12	3.12	-96	1.50	1.52	1.60
-6	4.55	4.55	4.57	-52	3.00	3.00	3.05	-98	1.50	1.52	1.60
8	4.55	4.55	4.57	-54	2.85	2.87	2.92	-100	1.50	1.52	1.60
-10	4.55	4.55	457	-56	2.70	2.70	2.77	-102	1.50	1.52	1.60
12	4.55	4.55	4.57	-58	2.57	2.57	2.62	-104	1.50	1.52	1.60
14	4.55	4.55	4.57	-60	2.45	2.47	2.50	-106	1.50	1.50	1.60
-16	4.55	4.55	455	-62	2.37	2.37	2.40	-108	1.50	1.50	1.60
18	4.52	4.52	4.55	-64	2.27	2.30	2.30	-110	1.50	1.50	1.60
-20	4.50	4.50	452	-66	2.20	2.20	2.22	-112			
22	4.45	4.45	447	-68	2.10	2.12	2.12	-114			
-24	4.37	4.40	440	-70	2.00	2.02	2.02	-116			
-26	4.32	4.32	435	-72	1.87	1.92	1.90	-118			
-28	4.25	4.27	427	-74	1.75	1.82	1.80	-120			
-30	4.17	4.17	4.20	-76	1.65	1.75	1.70	-122			
-32	4.07	4.07	4.12	-78	1.55	1.67	1.65	-124			
-34	3.92	3.92	4.00	-80	1.52	1.65	1.62	-126			
-36	3.77	3.77	3.82	-82	1.52	1.62	1.60	-128			
-38	3.65	3.65	3.67	-84	1.50	1.60	1.60	-130			
-40	3.55	3.55	3.57	-86	1.50	1.57	1.60	-132			
-42	3.45	3.45	3.47	-88	1.50	155	1.60	Noise	1.50	145	165
-44	3.35	3.35	337	-90	1.50	155	1.60				

IMP J 2dB CALIBRATION

Channel 0-1 KHz By WBR Attenuator in dB Below 1.0 V rms

Dates: Hot 197 Temperature: Hot 30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.57	4.57	4.55	-46	3.27	3.27	3.27	-92	1.57	1.55	1.62
-2	4.57	4.57	4.55	-48	3.20	3.20	3.20	-94	1.57	1.55	1.62
-4	4.57	4.57	4.55	-50	3.10	3.10	3.12	-96	1.57	1.52	1.62
-6	4.57	4.57	4.55	-52	3.00	3.00	3.02	-98	1.55	1.52	1.62
-8	4.57	4.57	4.55	-54	2.85	2.87	2.90	-100	1.55	1.52	1.62
-10	4.57	4.57	4.55	-56	2.70	2.70	2.75	-102	1.55	1.52	1.62
-12	4.55	4.57	4.55	-58	2.57	2.57	2.60	-104	1.55	1.52	1.62
-14	4.55	4.55	4.55	-60	2.47	2.47	2.50	-106	1.55	1.52	1.62
-16	4.55	4.55	4.55	-62	2.37	2.37	2.40	-108	1.55	1.52	1.62
-18	4.52	4.52	4.52	-64	2.27	2.30	2.30	-110	1.55	1.52	1.62
-20	4.50	4.50	4.50	-66	2.20	2.20	2.22	-112			
-22	4.45	4.45	4.45	-68	2.10	2.12	2.12	-114			
-24	4.37	4.40	4.40	-70	2.00	2.02	2.02	-116			
-26	4.32	4.32	4.35	-72	1.87	1.92	1.92	-118			
-28	4.25	4.27	4.27	-74	1.75	1.80	1.85	-120			
-30	4.17	4.17	4.20	-76	1.67	1.75	1.80	-122			
-32	4.07	4.07	4.10	-78	1.62	1.67	1.72	-124			
-34	3.92	3.92	3.97	-80	1.57	1.65	1.70	-126			
-36	3.77	3.77	3.80	-82	1.57	1.60	1.67	-128			
-38	3.65	3.65	3.67	-84	1.57	1.57	1.65	-130			
-40	3.52	3.55	3.55	-86	1.57	1.55	1.62	-132			
-42	3.45	3.45	3.45	-88	1.55	1.55	1.62	Noise	1.55	1.52	1.67
-44	3.35	3.35	3.37	-90	1.55	1.55	1.62				

IMP J 2dB CALIBRATION

Channel 2 MHz WBR Attenuator in dB Below 10 mV V rms

Dates: Hot 196 Temperature: Hot 30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.60	4.57	4.57	-46	2.25	2.22	2.20	-92	1.07	1.17	.90
-2	4.52	4.50	4.50	-48	2.17	2.12	2.12	-94	1.07	1.17	.90
-4	4.45	4.45	4.42	-50	2.07	2.05	2.02	-96	1.07	1.17	.90
-6	4.37	4.37	4.37	-52	1.77	1.95	1.92	-98	1.07	1.17	.90
-8	4.32	4.30	4.30	-54	1.87	1.82	1.80	-100	1.07	1.17	.90
-10	4.22	4.22	4.22	-56	1.72	1.67	1.67	-102			
-12	4.15	4.12	4.12	-58	1.60	1.55	1.52	-104			
-14	4.02	4.00	4.00	-60	1.50	1.47	1.42	-106			
-16	3.85	3.82	3.82	-62	1.42	1.40	1.32	-108			
-18	3.70	3.67	3.67	-64	1.32	1.35	1.22	-110			
-20	3.60	3.55	3.55	-66	1.27	1.30	1.15	-112			
-22	3.50	3.45	3.45	-68	1.20	1.25	1.10	-114			
-24	3.40	3.37	3.37	-70	1.17	1.22	1.02	-116			
-26	3.32	3.30	3.27	-72	1.15	1.20	1.00	-118			
-28	3.25	3.20	3.20	-74	1.12	1.17	.97	-120			
-30	3.15	3.12	3.12	-76	1.12	1.17	.95	-122			
-32	3.05	3.02	3.02	-78	1.12	1.17	.95	-124			
-34	2.92	2.87	2.90	-80	1.12	1.17	.95	-126			
-36	2.77	2.72	2.72	-82	1.12	1.17	.92	-128			
-38	2.62	2.60	2.60	-84	1.12	1.17	.72	-130			
-40	2.50	2.47	2.47	-86	1.10	1.17	.72	-132			
-42	2.42	2.37	2.37	-88	1.10	1.17	.72	Noise	1.07	1.05	.92
-44	2.32	2.30	2.27	-90	1.10	1.17	.92				

IMP J 2dB CALIBRATION

Channel 500 KHz WBR Attenuator in dB Below 10 mv V rms

Dates: Hot 193 Temperature: Hot 30°C

Room 203 Room

Cold 194 Cold −20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.60	4.65	4.60	-46	2.30	2.32	2.27	-92	.95	.90	.77
-2	4.52	4.57	4.52	-48	2.20	2.25	2.17	-94	.95	.90	.77
-4	4.47	4.50	4.45	-50	2.12	2.15	2.10	-96	.95	.90	.77
-6	4.40	4.42	4.40	-52	2.05	2.07	2.02	-98	.95	.87	.77
-8	4.32	4.37	4.32	-54	1.95	1.97	1.92	-100	.95	.87	.77
-10	4.27	4.30	4.25	-56	1.80	1.87	1.77	-102			
-12	4.20	4.22	4.17	-58	1.65	1.72	1.62	-104			
-14	4.10	4.15	4.07	-60	1.55	1.57	1.50	-106			
-16	3.95	4.02	3.92	-62	1.45	1.47	1.40	-108			
-18	3.80	3.85	3.77	-64	1.35	1.35	1.30	-110			
-20	3.65	3.72	3.65	-66	1.25	1.27	1.22	-112			
-22	3.55	3.60	3.52	-68	1.17	1.20	1.15	-114			
-24	3.45	3.50	3.42	-70	1.12	1.12	1.07	-116			
-26	3.37	3.40	3.35	-72	1.05	1.05	1.00	-118			
-28	3.30	3.32	3.27	-74	1.02	1.00	.95	-120			
-30	3.20	3.25	3.17	-76	1.00	.97	.87	-122			
-32	3.12	3.15	3.10	-78	.97	.95	.87	-124			
-34	3.02	3.07	3.00	-80	.97	.92	.85	-126			
-36	2.87	2.95	2.85	-82	.95	.90	.82	-128			
-38	2.72	2.77	2.70	-84	.95	.90	.80	-130			
-40	2.57	2.65	2.55	-86	.95	.90	.80	-132			
-42	2.47	2.52	2.45	-88	.95	.90	.80	Noise	.92	.85	.77
-44	2.37	2.42	2.35	-90	.95	.90	.80				

IMP J 2dB CALIBRATION

Channel 125 KHZ WBR Attenuator in dB Below 10 mV V rms

Dates: Hot 193 Temperature: Hot 30°C

Room 203 Room

Cold 194 Cold -20°C

ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.57	4.57	4.60	-46	2.27	2.25	2.25	-92	.67	.65	.60
-2	4.50	4.50	4.52	-48	2.17	2.17	2.17	-94	.67	.65	.60
-4	4.45	4.42	4.45	-50	2.10	2.10	2.10	-96	.67	.65	.60
-6	4.37	4.37	4.37	-52	2.02	2.00	2.00	-98	.67	.65	.60
-8	4.32	4.30	4.32	-54	1.90	1.90	1.90	-100	.67	.65	.60
-10	4.25	4.22	4.25	-56	1.75	1.72	1.75	-102			
-12	4.17	4.15	4.17	-58	1.60	1.57	1.60	-104			
-14	4.07	4.05	4.05	-60	1.50	1.47	1.47	-106			
-16	3.90	3.87	3.90	-62	1.37	1.35	1.37	-108			
-18	3.75	3.72	3.75	-64	1.30	1.27	1.27	-110			
-20	3.62	3.60	3.62	-66	1.20	1.20	1.20	-112			
-22	3.52	3.50	3.50	-68	1.12	1.10	1.10	-114			
-24	3.42	3.42	3.42	-70	1.02	1.02	1.02	-116			
-26	3.35	3.32	3.32	-72	.95	.92	.92	-118			
-28	3.27	3.25	3.25	-74	.87	.87	.85	-120			
-30	3.17	3.17	3.17	-76	.82	.80	.80	-122			
-32	3.10	3.07	3.07	-78	.77	.75	.72	-124			
-34	3.00	2.97	2.97	-80	.75	.72	.67	-126			
-36	2.82	2.80	2.82	-82	.72	.70	.67	-128			
-38	2.67	2.65	2.67	-84	.70	.70	.65	-130			
-40	2.55	2.52	2.55	-86	.70	.67	.62	-132			
-42	2.45	2.42	2.42	-88	.70	.67	.62	Noise	.67	.65	.62
-44	2.35	2.32	2.32	-90	.67	.65	.62				

IMP J 2dB CALIBRATION

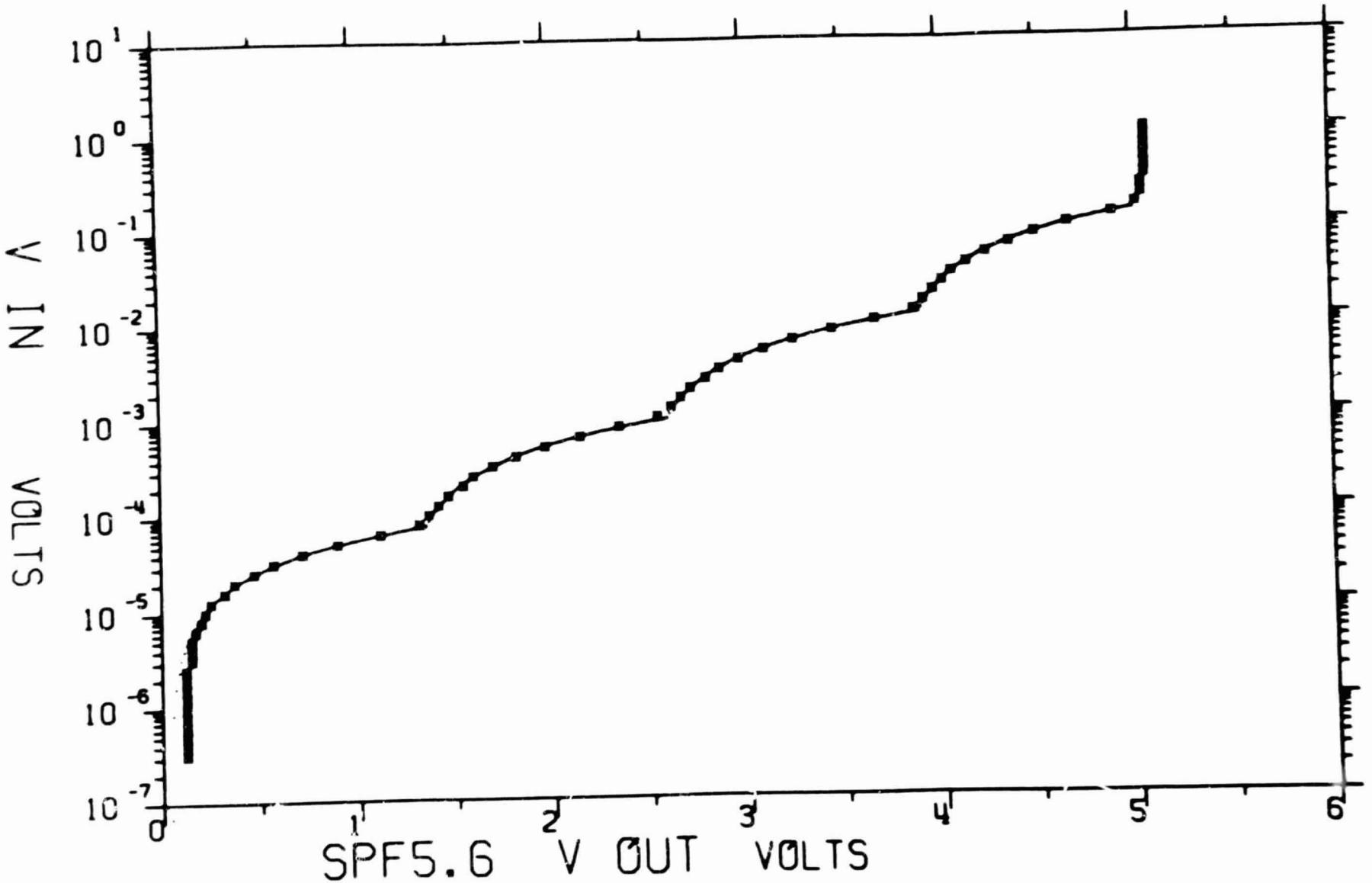
Channel 31.1 KHz WBR Attenuator in dB Below 10 MW V rms

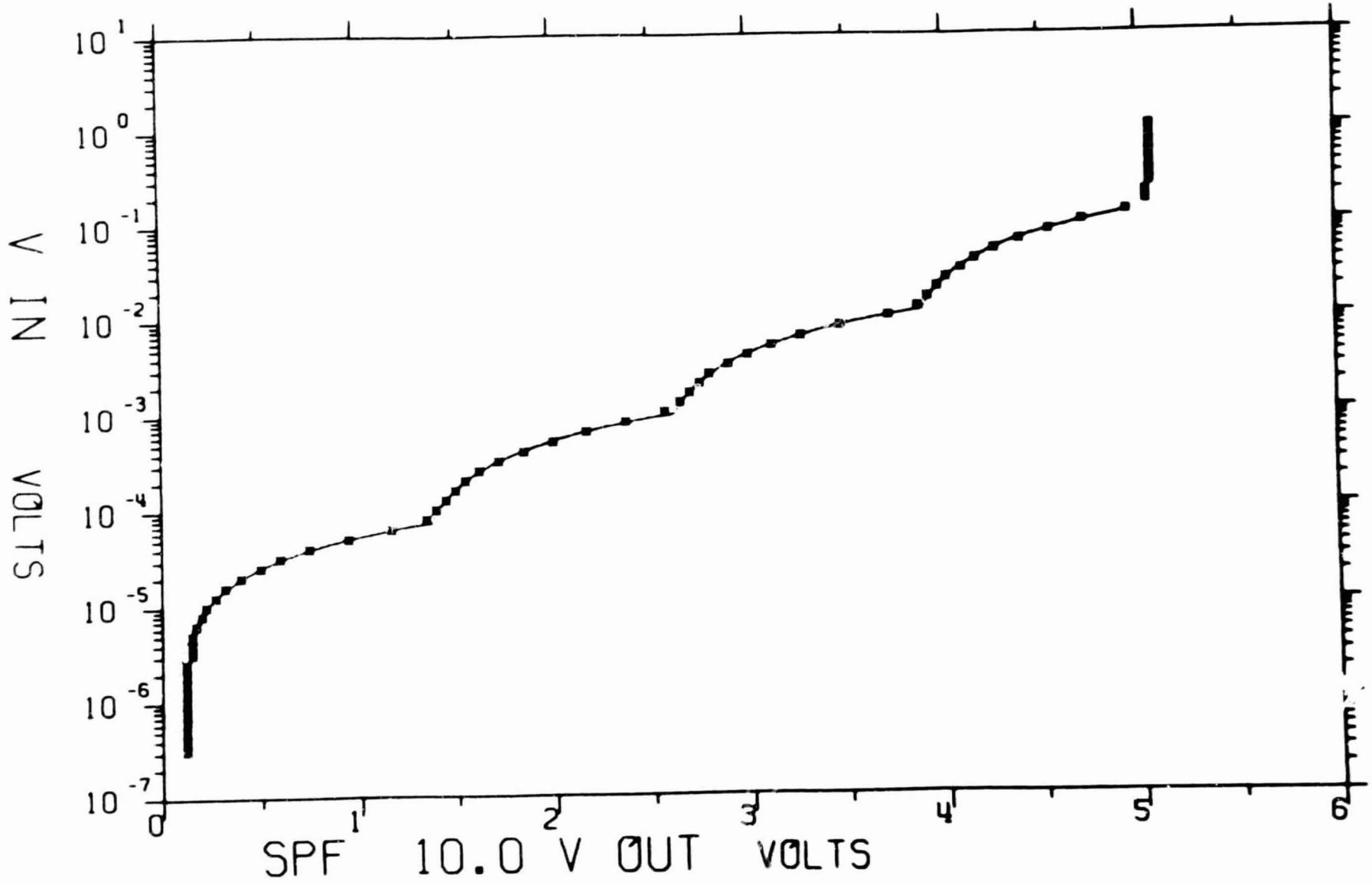
Dates: Hot 193 Temperature: Hot 130°C

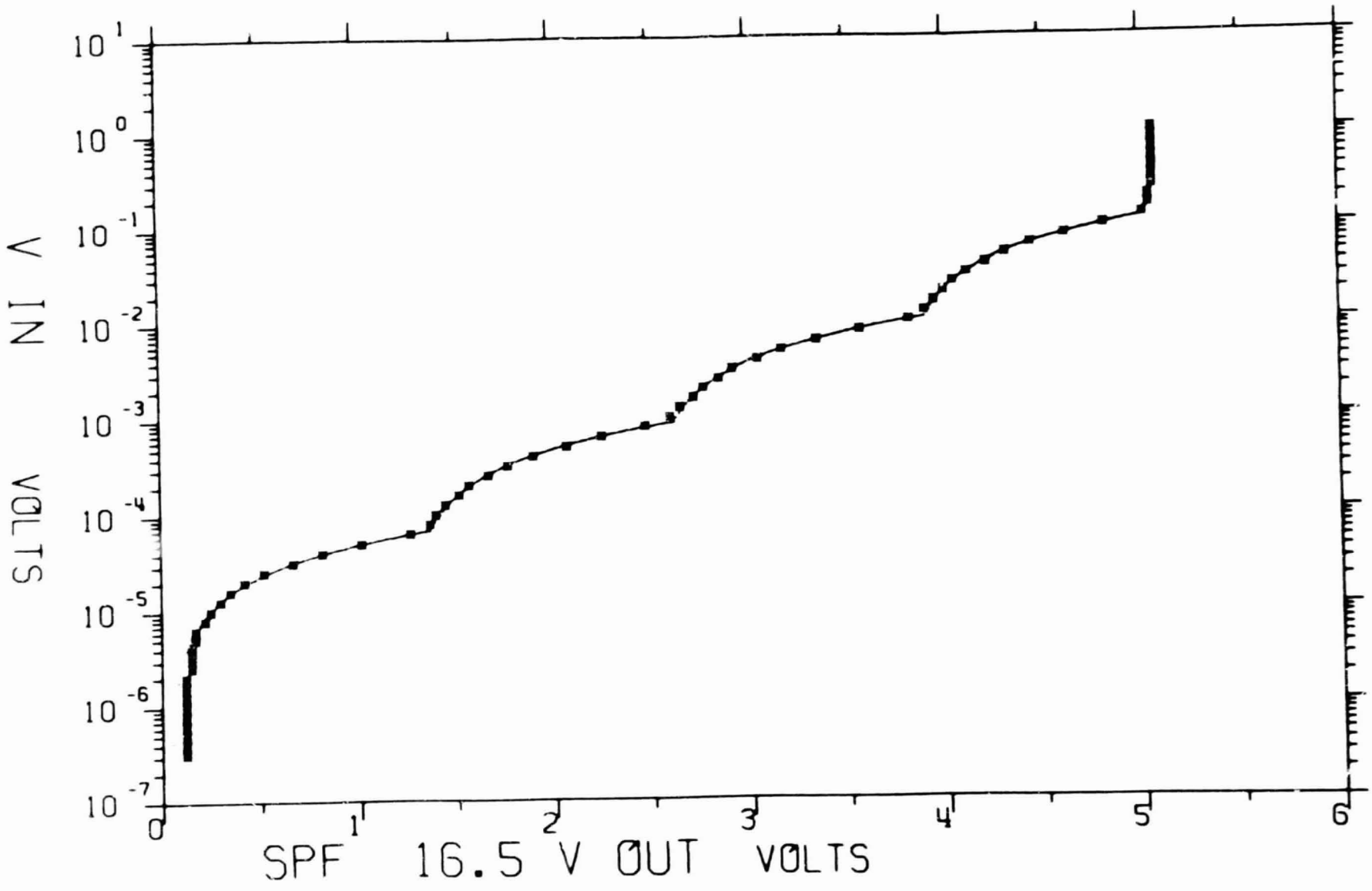
Room 203 Room

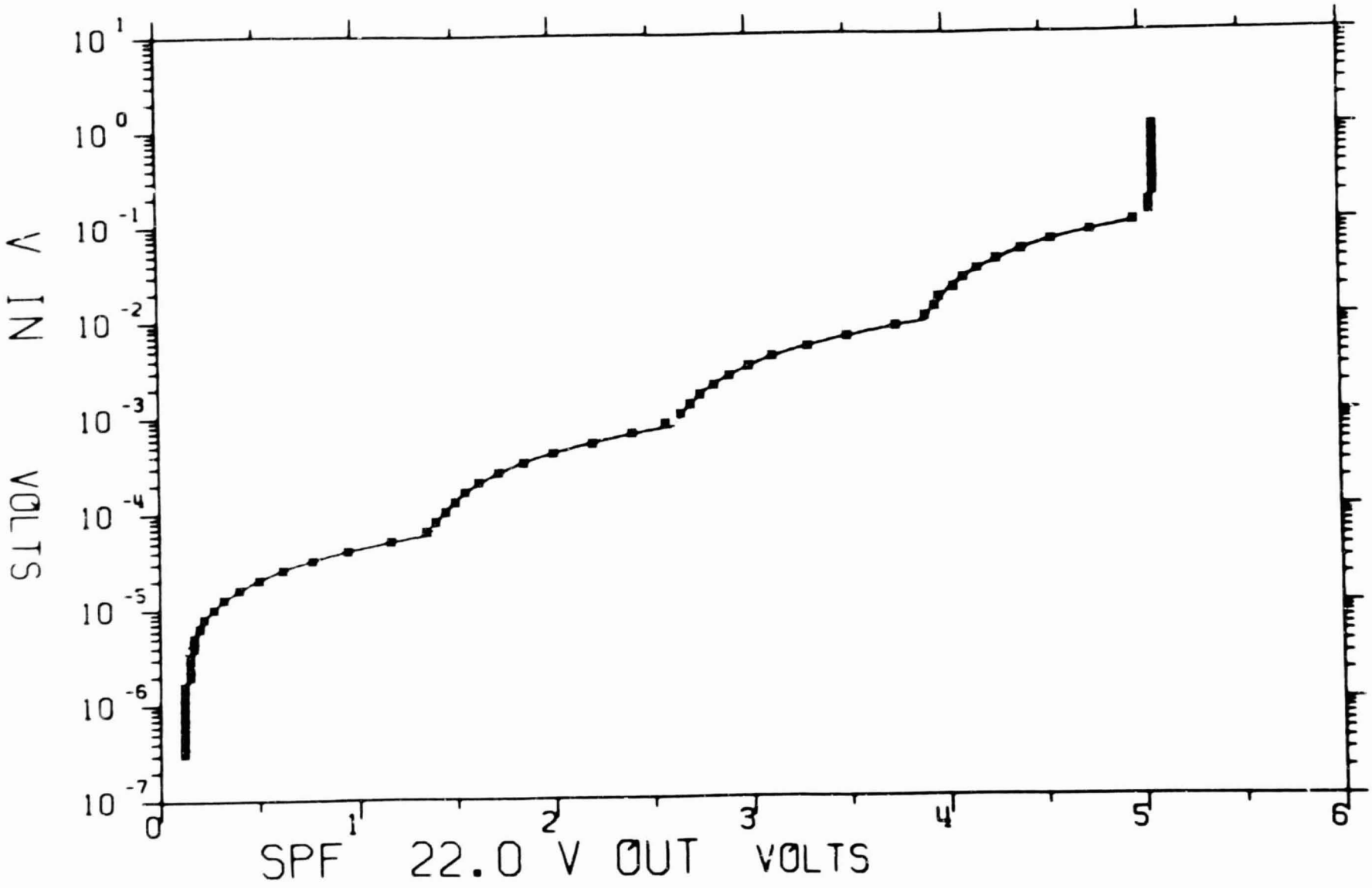
Cold 194 Cold -20°C

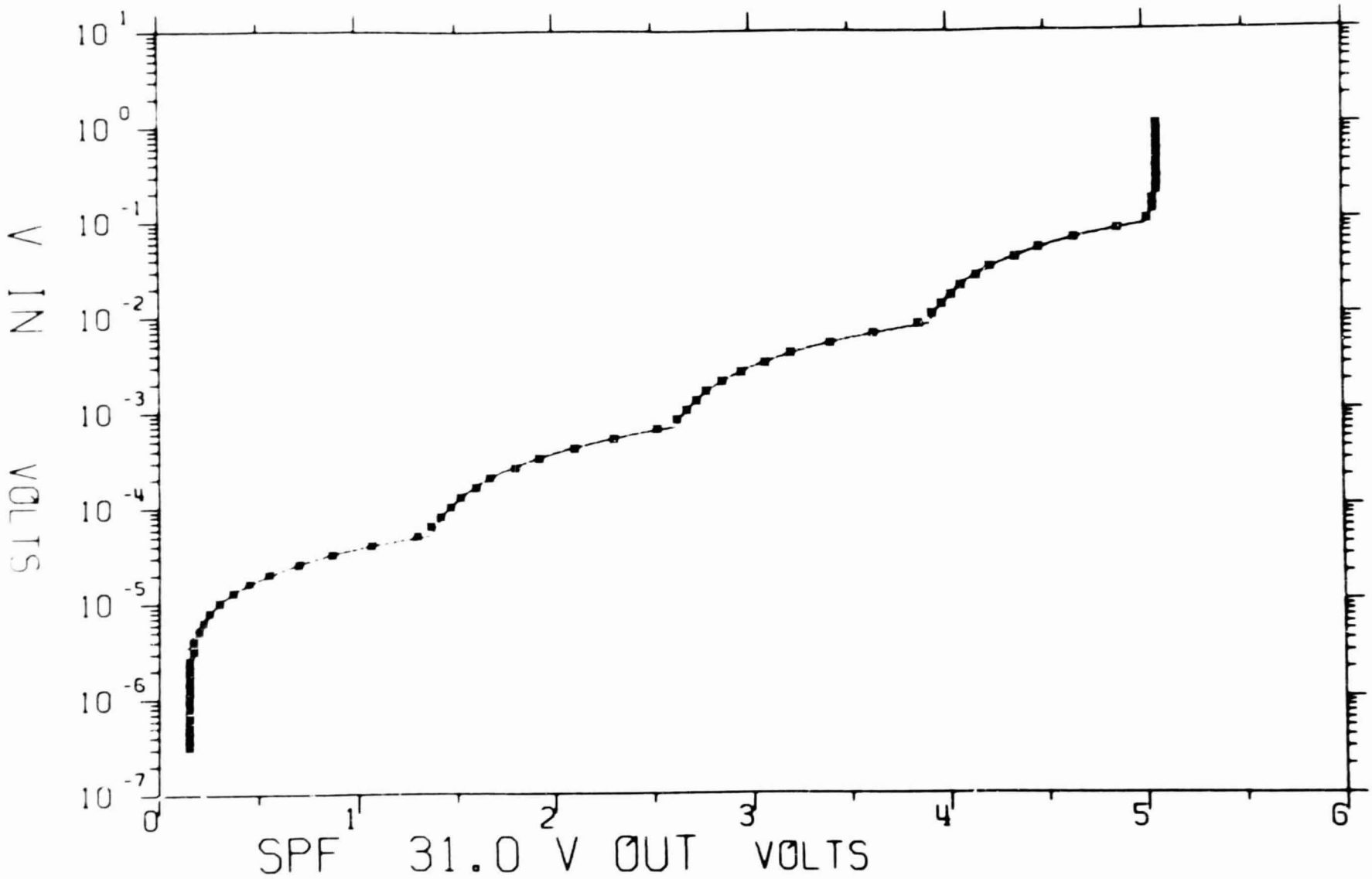
ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD	ATTEN	HOT	ROOM	COLD
0	4.12	4.12	4.12	-46	1.52	1.52	1.55	-92	.25	.22	.22
-2	4.00	4.00	4.02	-48	1.40	1.42	1.42	-94	.25	.22	.22
-4	3.85	3.82	3.85	-50	1.32	1.32	1.32	-96	.25	.22	.22
-6	3.70	3.70	3.70	-52	1.22	1.22	1.22	-98	.25	.22	.20
-8	3.57	3.57	3.57	-54	1.15	1.15	1.15	-100	.25	.22	.20
-10	3.47	3.47	3.47	-56	1.07	1.07	1.05	-102			
-12	3.40	3.40	3.37	-58	.97	1.00	.97	-104			
-14	3.32	3.30	3.30	-60	.90	.90	.90	-106			
-16	3.25	3.22	3.22	-62	.77	.77	.77	-108			
-18	3.15	3.15	3.15	-64	.65	.67	.65	-110			
-20	3.07	3.05	3.05	-66	.55	.55	.52	-112			
-22	2.92	2.92	2.95	-68	.45	.45	.45	-114			
-24	2.77	2.75	2.77	-70	.37	.40	.37	-116			
-26	2.62	2.62	2.62	-72	.35	.37	.32	-118			
-28	2.50	2.50	2.50	-74	.30	.32	.27	-120			
-30	2.40	2.40	2.40	-76	.27	.30	.25	-122			
-32	2.32	2.30	2.30	-78	.25	.27	.25	-124			
-34	2.22	2.22	2.22	-80	.25	.25	.22	-126			
-36	2.15	2.15	2.15	-82	.25	.25	.22	-128			
-38	2.05	2.06	2.05	-84	.25	.25	.22	-130			
-40	1.97	1.97	1.97	-86	.25	.25	.22	-132			
-42	1.85	1.85	1.85	-88	.25	.22	.22	Noise	.25	.22	.20
-44	1.67	1.67	1.70	-90	.25	.22	.22				


V IN VOLTS
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
1
2
3
4
5
6
SPF5.6 V OUT VOLTS


V IN VOLTS
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
1
2
3
4
5
6
SPF 10.0 V OUT VOLTS


V IN VOLTS
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
1
2
3
4
5
6
SPF 16.5 V OUT VOLTS


V IN VOLTS
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
1
2
3
4
5
6
SPF 22.0 V OUT VOLTS


V IN VOLTS
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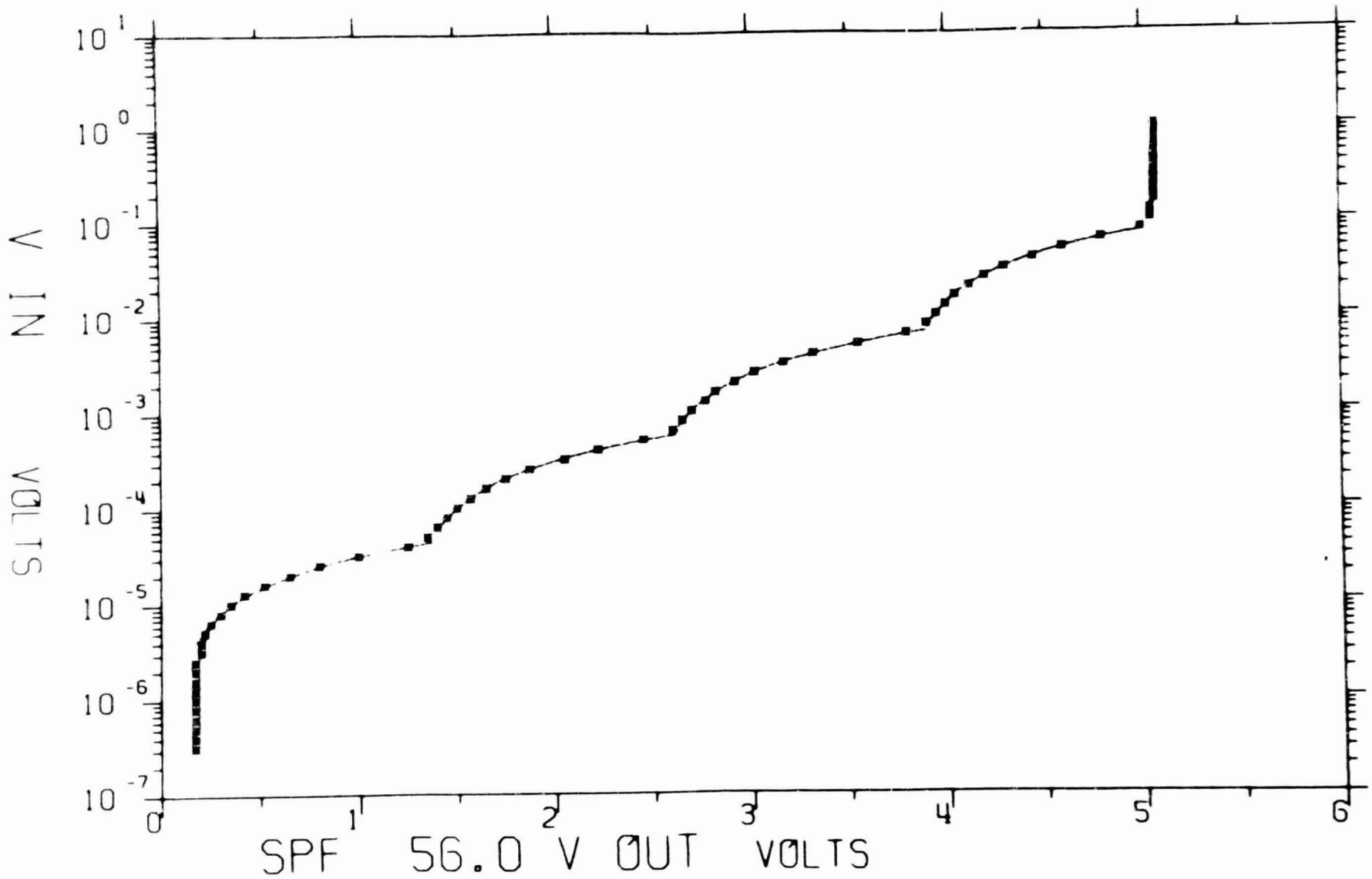
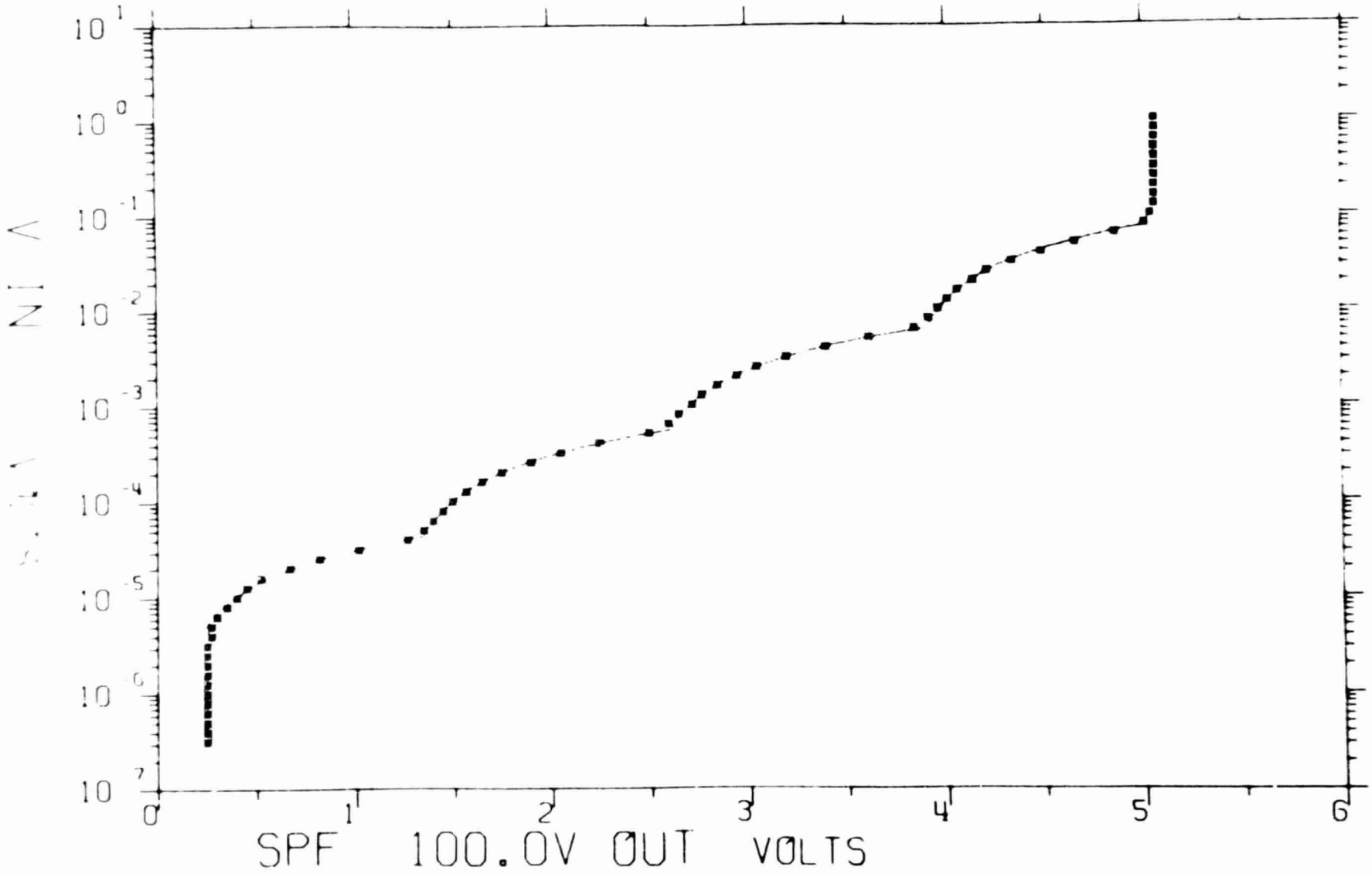
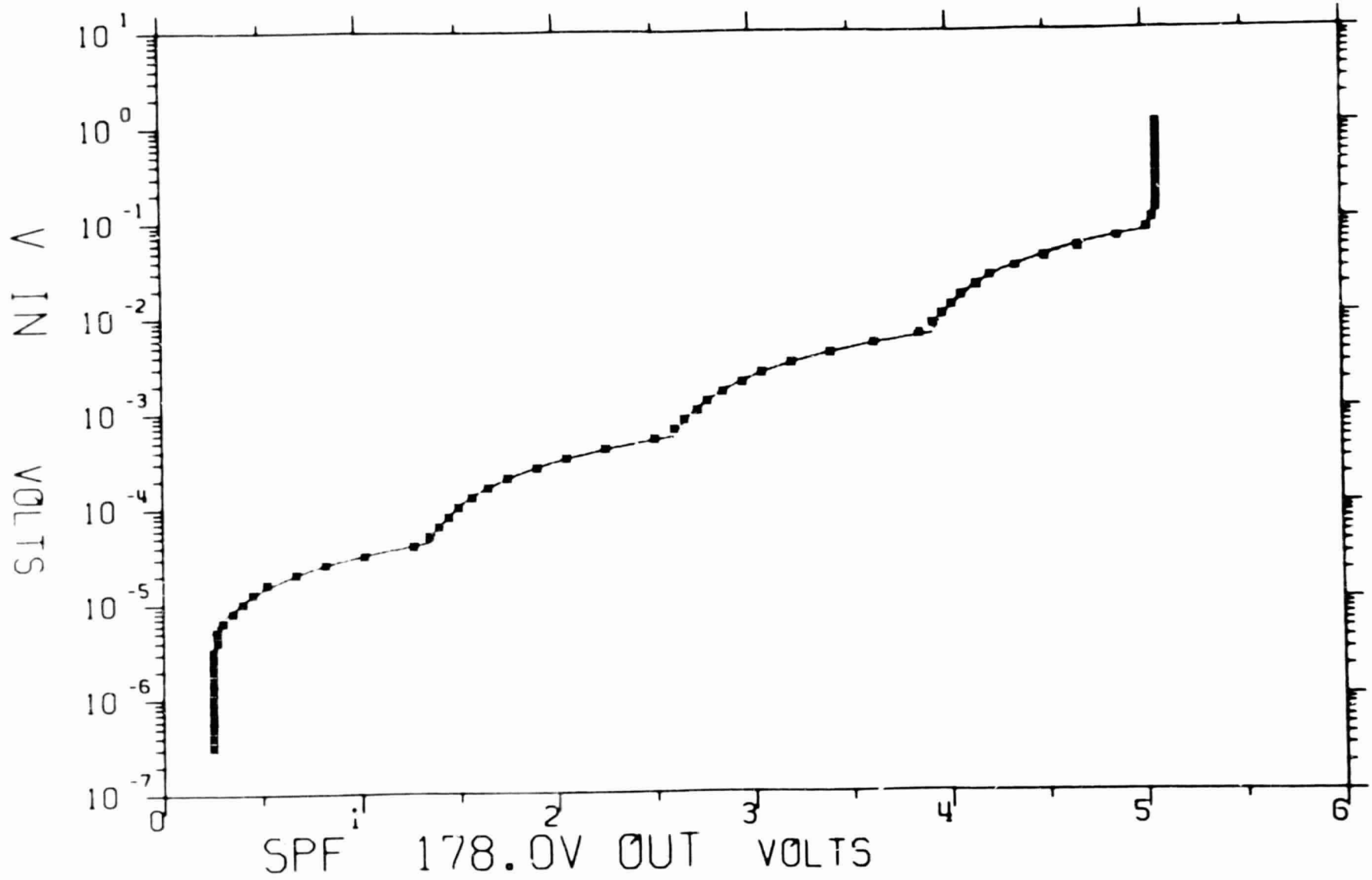
10 0
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
0
1
2
3
4
5
6
SPF 31.0 V OUT VOLTS


V IN VOLTS
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
1
2
3
4
5
6
SPF 56.0 V OUT VOLTS

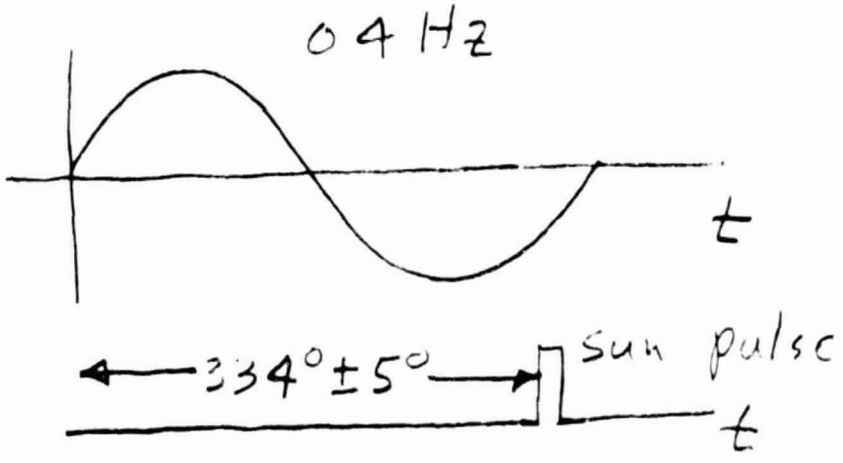

10 1
10 0
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
0
1
2
3
4
5
6
SPF 100.0V OUT VOLTS


V IN VOLTS
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
0
1
2
3
4
5
6
SPF 178.0V OUT VOLTS

5.4 Low-Frequency Wave Form Amplifier Calibrations

5.4.1 Ordering of the Se Samples.

The four low frequency waveform channels (Se-1, Se-2, Se-3, and Se-4) are sampled at 16 equally spaced angles during one complete rotation (see section on Timing for details). These outputs are labeled (1)16, (2)16, .., up to (16)16. The ordering of these samples was determined by driving the Ex and Ey inputs with a 0.4 Hz sine wave and displaying the sampled values on a printout as shown in Table 5.4-1. The sine wave in this case was synchronized to the sun pulse with an angle of 334° ± 5° from the zero crossing of the sine wave and the sun pulse as shown below.



The Se-1 and Se-2 values in Table 5.4-1 clearly show that the sampling occurs in the expected sequence. The exact angles of the +x and +y axes with respect to the sun (as computed from the encoder timing) are summarized in Table 5.4-2. To compute these angles one must take into account the time delay from the sun

pulse to the time the A/D conversion is actually occurring. These time delays are summarized in Table 5.4-3.

5.4.2 Gain of the Low Frequency Waveform Amplifier.

The gains of K_{EX} and K_{EY} waveform amplifiers is defined by the following equation

$$V_{X+} - V_{X-} = K_{EX}(Se\text{-}1 - \delta_{EX})$$

$$V_{Y+} - V_{Y-} = K_{EY}(Se\text{-}2 - \delta_{EY})$$

The voltages δ_{EX} and δ_{EY} are offset voltages for these channels. The nominal offset voltages are δ_{EX} = 2.52 volts and δ_{EY} = 2.50 volts. These offsets may, however, vary by ~ 0.050 volts and should be determined by averaging a large number of Se readings. The sign of the gain factors have been determined to be negative (i.e., a positive voltage applied to the +X antenna with the -X antenna grounded gives a negative output). The gains are

$$K_{EX} = -0.80$$

$$K_{EY} = -0.80$$

The electric fields can then be calculated from the equations

$$E_x = \frac{0.8}{\ell_x} \; [(Se\text{-}1) - 2.52]$$

$$E_y = \frac{0.8}{\ell_y} \; [(Se\text{-}2) - 2.50]$$

The nominal values for the effective lengths of the Ex and Ey antennas are

$$\ell_x = (395.45 - 50.25) \text{ ft } \left(\frac{1 \text{ meter}}{3.280 \text{ ft.}}\right)$$

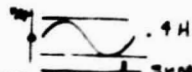
$$\ell_x = 105.24 \text{ meters}$$

$$\ell_y = (399.45 - 50.25) \text{ ft } \left(\frac{1 \text{ meter}}{3.280 \text{ ft.}}\right)$$

$$\ell_y = 106.45 \text{ meters}$$

$$E_x = (7.602 \times 10^{-3})[(Se\text{-}1) - 2.52]$$

$$E_y = (7.514 \times 10^{-3})[(Se\text{-}2) - 2.50]$$



IMP INTEGRATION — START Sun Pulse — FEB 06 1934 41

IMP-J 19F AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (IBMA - GURNETT) HIGH BIT RATE S/C CLOCK 100262 PG 1 FEB 01 2120 46

IEF	KHZ	P	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	1.37	1	5.60	0.35	/ EX	EY	BX	BY
1	.100	0.35	1	10.0	0.52	1.50	1.55	5.33	5.33
2	.178	1.10	1	16.5	0.70	2.45	2.50	5.60	5.60
3	.311	0.72	1	22		1.07	3.47	3.47	5.60	5.60
4	.560	0.50	1	31		1.22	4.27	4.32	5.60	5.60
5	1.00	0.95	1	56		1.45	4.82	4.87	5.60	5.60
6	1.78	0.72	1	100		1.62	5.05	5.07	5.60	5.60
7	.040	2.50	1	178		2.60	4.90	4.87	5.60	5.60
8	.100	1.10	2	0=1		1.95	4.37	4.32	5.60	5.60
9	.178	1.47	2	61+		2.00	3.52	3.47	5.60	5.60
10	.311	1.07	2			1.92	2.52	2.47	5.33	5.33
11	.560	0.22	2			1.97	1.55	1.47	5.33	5.33
12	1.00	0.12	2			1.95	0.75	0.67	5.33	5.33
13	1.78	0.15	2			1.97	0.22	0.17	5.33	5.33
	AGC		2			2.00	0.05	0.02	5.33	5.33
14	1111	2.55	2			2.05	0.22	0.22	5.33	5.33
15	1024	2.47					0.75	0.77	5.33	5.33
16	2604+	2.57	114T	1		EX		EY		BX		BY		BZ
17		2.46	115T	1		0.058		0.106		0.020		0.028		0.000
18	1111	2.50	116T	1										
19	1024	2.52	117T	0	ANG EX		ANG EY		ANG BX		ANG BY		ANG BZ	
20		2.52	118T	0	-31.1		+44.9		90.0		45.0		90.0	
21		2.52	119T	1										
22		2.50							PX		PY		PZ	
23		2.50							0.000		0.000		+1.000	

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	1.42	1	5.60	0.40	EX	EY	BX	BY
1	.100	0.27	1	10.0	0.55	1.50	1.50	5.31	5.31
2	.178	0.87	1	16.5	0.72	2.45	2.47	5.60	5.60
3	.311	0.72	1	22		1.07	3.40	3.47	5.60	5.60
4	.560	0.67	1	31		1.22	4.25	4.30	5.60	5.60
5	1.00	0.67	1	56		1.45	4.85	4.87	5.60	5.60
6	1.78	0.75	1	100		1.62	5.07	5.07	5.60	5.60
7	.040	2.37	1	178		2.62	4.92	4.90	5.60	5.60
8	.100	1.80	2	0=1		2.05	4.40	4.35	5.60	5.60
9	.178	2.20	2	61+		2.02	3.57	3.50	5.60	5.60
10	.311	1.19	2			2.05	2.57	2.50	5.31	5.33
11	.565	1.02	2			2.10	1.57	1.50	5.31	5.33
12	1.00	0.87	2			1.97	0.75	0.70	5.31	5.33
13	1.78	0.65	2			2.05	0.22	0.17	5.31	5.33
	AGC		2			1.97	0.05	0.02	5.31	5.33
14	1111	2.47	2			2.02	0.25	0.25	5.33	5.31
15	1024	2.47					0.77	0.77	5.33	5.31
16	2604+	2.32	114T	1		EX		EY		BX		BY		BZ
17		2.30	115T	1		0.133		0.180		0.050		0.053		0.000
18	1111	2.50	116T	1										
19	1024	2.55	117T	0	ANG EX		ANG EY		ANG BX		ANG BY		ANG BZ	
20		2.52	118T	0	-167.1		-180.0		90.0		69.1		90.0	
21		2.55	119T	1										
22		2.50			AP-01		23.4					PX	PY	PZ
23		2.50			AP-12		4.85					0.000	0.000	+1.000

IMP-J 19F AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (IBMA - GURNETT) HIGH BIT RATE S/C CLOCK 100262 PG 2 FEB 01 2121 05

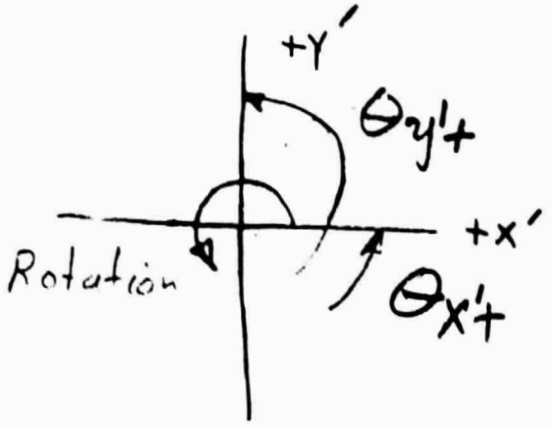
IEF	KHZ	P	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	1.37	1	5.60	0.37	EX	EY	BX	BY
1	.100	0.30	1	10.0	0.52	1.50	1.52	5.31	5.33
2	.178	1.10	1	16.5	0.70	2.42	2.45	5.60	5.60
3	.311	0.72	1	22		1.07	3.45	3.50	5.60	5.60
4	.560	0.55	1	31		1.22	4.30	4.35	5.60	5.60
5	1.00	0.57	1	56		1.45	4.85	4.90	5.60	5.60
6	1.78	0.70	1	100		1.62	5.07	5.07	5.60	5.60
7	.040	2.47	1	178		2.62	4.90	4.90	5.60	5.60
8	.100	1.10	2	0=1		1.97	4.37	4.32	5.60	5.60
9	.178	1.50	2	61+		1.97	3.52	3.47	5.60	5.60
10	.311	1.07	2			2.00	2.52	2.45	5.31	5.33
11	.560	0.22	2			1.97	1.55	1.47	5.31	5.33
12	1.00	0.12	2			1.92	0.75	0.67	5.31	5.33
13	1.78	0.15	2			1.97	0.22	0.17	5.31	5.33
	AGC		2			1.90	0.05	0.02	5.31	5.33
14	1111	2.52	2			2.02	0.25	0.25	5.31	5.33
15	1024	2.52					0.77	0.77	5.31	5.33
16	2604+	2.50	114T	1		EX		EY		BX		BY		BZ
17		2.50	115T	1		0.028		0.050		0.020		0.024		0.000
18	1111	2.50	116T	1										
19	1024	2.52	117T	0	ANG EX		ANG EY		ANG BX		ANG BY		ANG BZ	
20		2.52	118T	0	45.0		90.0		90.0		45.0		90.0	
21		2.52	119T	1										
22		2.50							PX		PY		PZ	
23		2.50							0.000		0.000		+1.000	

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	1.42	1	5.60	0.37	EX	EY	BX	BY
1	.100	0.25	1	10.0	0.55	1.52	1.55	5.31	5.33
2	.178	0.30	1	16.5	0.72	2.45	2.50	5.60	5.60
3	.311	0.70	1	22	1.07	3.47	3.47	5.60	5.60
4	.560	0.70	1	31	1.25	4.27	4.32	5.60	5.60
5	1.00	0.67	1	56	1.45	4.85	4.87	5.60	5.60
6	1.78	0.75	1	100	1.62	5.05	5.07	5.60	5.60
7	.040	2.42	1	178	2.62	4.90	4.90	5.60	5.60
8	.100	1.75	2	0=1	1.92	4.37	4.32	5.60	5.60
9	.178	2.22	2	61+	2.00	3.55	3.47	5.60	5.60
10	.311	1.32	2		2.00	2.55	2.47	5.31	5.33
11	.560	1.07	2		2.02	1.57	1.50	5.31	5.33
12	1.00	0.87	2		2.05	0.75	0.67	5.31	5.33
13	1.78	0.65	2		2.02	0.22	0.17	5.31	5.33
	AGC		2		2.00	0.05	0.02	5.31	5.33
14	1111	2.50	2		2.00	0.22	0.22	5.31	5.33
15	1024	2.57				0.75	0.75	5.31	5.33
16	2604+	2.42	114T	1		EX		EY		BX		BY		BZ
17		2.60	115T	1		0.070		0.104		0.058		0.058		0.000
18	1111	2.55	116T	1										
19	1024	2.47	117T	0	ANG EX		ANG EY		ANG BX		ANG BY		ANG BZ	
20		2.55	118T	0	90.0		106.6		-21.1		-31.1		90.0	
21		2.47	119T	1										
22		2.50										PX	PY	PZ
23		2.50			AP-12		4.85					-0.001	-0.001	-0.071

Table 5.4-1

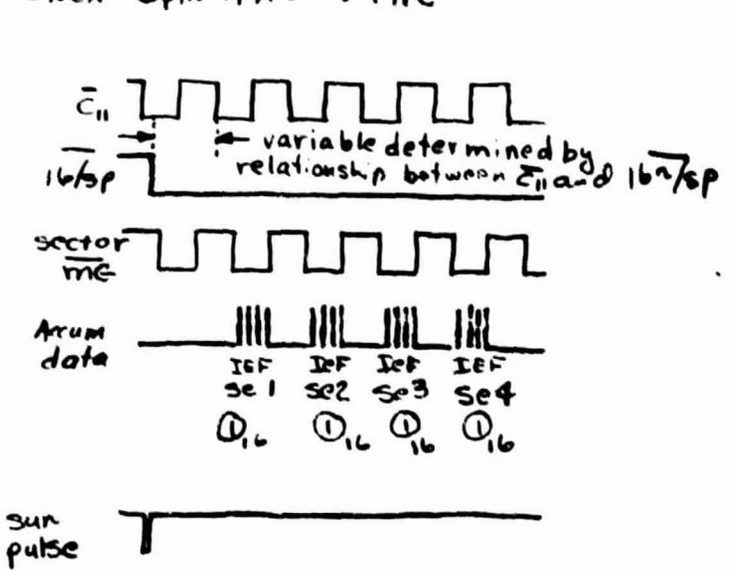
Table 5.4-2

Se Sampling Angles



	θ_{x+} Se-1	θ_{y+} Se-2	θ_{x+} Se-3	θ_{y+} Se-4
① 16	46.44 ± .72	137.88 ± .72	49.32 ± .72	140.76 ± .72
② 16	68.94 ± .72	160.38 ± .72	71.82 ± .72	163.26 ± .72
③ 16	91.44 ± .72	182.88 ± .72	94.32 ± .72	185.76 ± .72
④ 16	113.94 ± .72	205.38 ± .72	116.82 ± .72	208.26 ± .72
⑤ 16	136.44 ± .72	227.88 ± .72	139.32 ± .72	230.76 ± .72
⑥ 16	158.94 ± .72	250.38 ± .72	161.82 ± .72	253.26 ± .72
⑦ 16	181.44 ± .72	272.88 ± .72	184.32 ± .72	275.76 ± .72
⑧ 16	203.94 ± .72	295.38 ± .72	206.82 ± .72	298.26 ± .72
⑨ 16	226.44 ± .72	317.88 ± .72	224.32 ± .72	320.76 ± .72
⑩ 16	248.94 ± .72	340.38 ± .72	251.82 ± .72	343.26 ± .72
⑪ 16	271.44 ± .72	2.88 ± .72	274.32 ± .72	5.76 ± .72
⑫ 16	293.94 ± .72	25.38 ± .72	296.82 ± .72	28.26 ± .72
⑬ 16	316.44 ± .72	47.88 ± .72	319.32 ± .72	50.76 ± .72
⑭ 16	338.94 ± .72	70.38 ± .72	341.82 ± .72	73.26 ± .72
⑮ 16	1.44 ± .72	92.88 ± .72	4.32 ± .72	95.76 ± .72
⑯ 16	23.94 ± .72	115.38 ± .72	26.82 ± .72	118.26 ± .72

Table 5.4-3



Time Delays from Sun Pulse Angular Delay @ .4 Hz

	Min	Max	Min	Max	
Se-1 ① 16	5ms	15ms	.72°	2.16°	1.42 ± .72°
Se-2 ① 16	15ms	25ms	2.16°	3.60°	2.88 ± .72°
Se-3 ① 16	25ms	35ms	3.60°	5.04°	4.32 ± .72°
Se-4 ① 16	35ms	45ms	5.04°	6.48°	5.76 ± .72°

TIME DELAYS FROM START OF HALF PAGE TO SAMPLE TIME

	Time Delay (Counts)	Time Delay (Ms.)	Theta**	θ_E (Electronic Phase Shift)	θ_A (Antenna Phase Shift)	θ_s
IEF0	992	154.85	21.52	-14.3	+90(EY)	97.22
IEF1	1056	164.84	22.90	-14.3	+90(EY)	98.60
IEF2	1120	174.83	24.29	-14.3	+90(EY)	99.99
IEF3	1184	184.82	25.68	-14.3	+90(EY)	101.38
IEF4	1248	194.81	27.07	-14.3	+90(EY)	102.77
IFF5	1312	204.80	28.46	-14.3	+90(EY)	104.16
IEF6	1376	214.79	29.84	-14.3	+90(EY)	105.54
IEF7	1440	224.78	31.23	-14.3	0(BX)	16.93
IEF8	1504	234.77	32.62	-14.3	0(BX)	18.32
IEF9	1568	244.76	34.01	-14.3	0(BX)	19.71
IEF10	1632	254.75	35.40	-14.3	0(BX)	21.10
IEF11	1696	264.74	36.79	-14.3	0(BX)	22.49
IEF12	1760	274.73	38.17	-14.3	0(BX)	23.87
IEF13	1824	284.72	39.56	-14.3	0(BX)	25.26
SFR1 5.6	4784	746.75	103.76	- 7.16	+90(EY)	186.60
SFR1 10	12976	2025.47	281.44	- 7.16	+90(EY)	3.84
SFR1 16.5	21168	3304.20	99.12	- 7.16	+90(EY)	181.96
SFR1 22	29360	4582.92	276.80	- 7.16	+90(EY)	359.64
SFR1 31.1	37552	5861.64	94.48	- 7.16	+90(EY)	117.32
SFR1 56.0	45744	7140.36	272.16	- 7.16	+90(EY)	355.00
SFR1 100	53936	8419.08	89.84	- 7.16	+90(EY)	172.68
SFR1 178	62128	9697.80	267.52	- 7.16	+90(EY)	350.36
SFR2(1)	6832	1066.43	148.18	-14.3	+90(BY,EY)	223.88
					+ 0(BX)	133.88
SFR2(2)	15024	2345.15	325.86	-14.3	+90(BY,EY)	41.56
					+ 0 (BX)	311.56
SFR2(3)	23216	3623.88	143.54	-14.3	+90(BY,EY)	219.24
					+ 0(BX)	129.24
SFR2(4)	31408	4902.60	321.22	-14.3	+90(BY,EY)	36.92
					+ 0(BX)	306.92
SFR2(5)	39600	6181.32	138.90	-14.3	+90(BY,EY)	214.60
					+0(BX)	124.60
SFR2(6)	47792	7460.04	316.58	-14.3	+90(BY,EY)	32.28
					+0(BX)	302.28
SFR2(7)	55984	8738.76	134.26	-14.3	+90(BY,EY)	209.96
					+0(BX)	119.96
SFR2(8)	64176	10017.48	311.94	-14.3	+90(BY,EY)	27.64
					+0(BX)	297.64

*Assumes a clock frequency of 6.4064 kHz
**Assumes a OAST Value of $403268 = 16598_{10}$ counts (2.5909 sec period = .386 Hz)

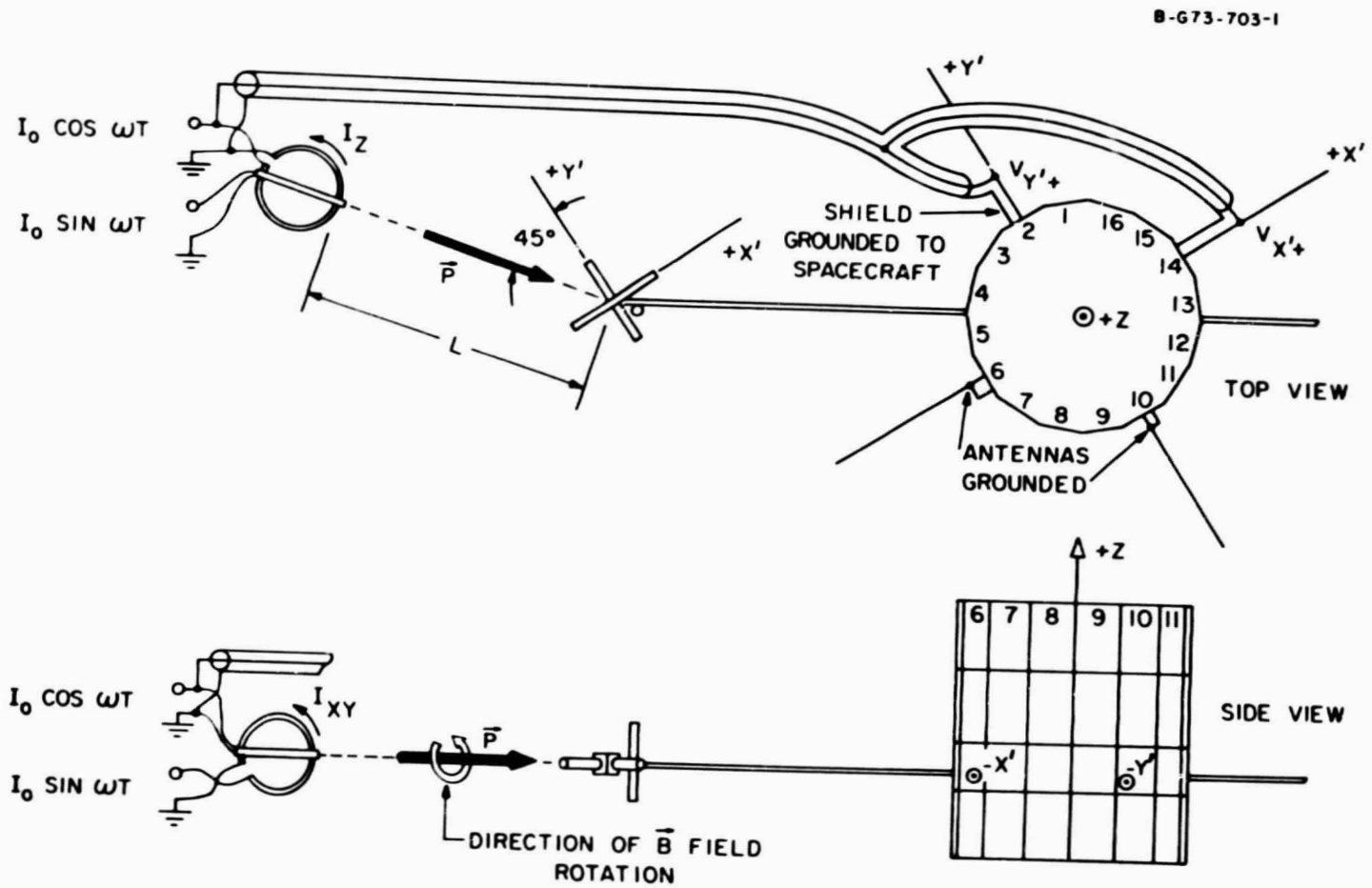

B-G73-703-1
I_0 COS ωT
I_0 SIN ωT
I_Z
+Y'
45°
$\vec{P}$
+X'
L
+Y'
$V_{Y'+}$
+X'
SHIELD GROUNDED TO SPACECRAFT
$V_{X'+}$
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
⊙+Z
TOP VIEW
ANTENNAS GROUNDED
+Z
6
7
8
9
10
11
I_0 COS ωT
I_0 SIN ωT
I_{XY}
$\vec{P}$
⊙-X'
⊙-Y'
SIDE VIEW
DIRECTION OF $\vec{B}$ FIELD ROTATION

Figure 5.5.1

The telemetry channels are 40_8 counts wide $\simeq$ 5 m

$$TD \text{ (time delay in counts)} = SS \times 20_8^3 + SEQ \times 20_8^2 + FR \times 20_8 + CH + 10_8$$

time delay is measured from the beginning of the 1/2 page to the time of the middle of the sampling channel.

SS = snapshot number (0, 1, 2, 3)
SEQ = sequence number (0, 1, 2, 3)
FR = frame number ($0 \leq FR \leq 16$)
CH = channel number ($0 \leq CH \leq 16$)

$$\text{Time delay (msec)} = TD/6.4064 \times 10^3 \text{ Hz}$$

The sample angle is the angle between the sun line and the antenna which is being sampled, taking into account all phase shifts: θ_1, θ_2, θ, θ_E (Electronic phase shift), θ_A (physical location of antenna).

$$\theta_s \text{ (sample angle)} = \theta_{1,2} + \theta + \theta_A - \theta_E$$

5.5 Synchronous Five-Channel SFR Calibration

5.5.1 Calibration at the GSFC Magnetic Field Test Facility

A final prelaunch calibration of the SFR was performed on September 12, 1973, at the GSFC Magnetic Test facility. This test consisted of transmitting a rotating magnet at the center frequency of the SFR and recording the digital outputs (IEF-14 through IEF-23). The physical arrangement of the transmitting loop and the spacecraft is shown in Figure 5.5-1. The polarization vector $\vec{P}$ is normal to the plane of rotation of the magnetic field and in a direction given by the right-hand rule. The $\vec{P}$ vector was located at 45° between the +x and -y axes and in the x-y plane. The accuracy in orienting the $\vec{P}$ vector is estimated to be about ± 2 degrees. The physical parameters of the test setup shown in Figure 5.5-1 are as follows:

L = Loop to search coil distance = 45 in. (1.143 m)

R = Loop radius = 9 in. (.2286 m)

A = Loop area = 254.47 m^2 (.1642 m^2)

N = number of turns in the transmitting loop = 10

$I_Z = I_o \text{ Cos } \omega t$, $I_{xy} = I_o \text{ Sin } \omega t$

$V_{x'+} = V_{y'+} = V_o \text{ Cos } \omega t$

I_o = 0.318 amps

Data were recorded at the following times in this configuration and should be available upon request from the IMP-J project office or in the University of Iowa master science file.

Frequency	Start Time	Stop Time
30.6 Hz	1502:33 UT	1512:00 UT
61.5 Hz	1518:00 UT	1528:00 UT
124.0 Hz	1534:28 UT	1544:28 UT
252.0 Hz	1550:00 UT	1600:00 UT
520.0 Hz	1607:00 UT	1617:00 UT
1116.0 Hz	1622:00 UT	1632:00 UT
1802.0 Hz	1651:00 UT	1701:00 UT
2604.0 Hz	1712:00 UT	1722:00 UT

The transmitting coil was reoriented so that $\vec{P}$ was in the -z direction from 1728:00 to 1732:00 UT with the step frequency receiver tuned to the 2604.0 Hz channel.

Samples of the quick look printout obtained during this calibration are given for each frequency in Tables 5.5-1 through 5.5-8. The quantities listed in these printouts are defined in Section 4.0. The offset voltages X_{14} through X_{15} used in this printout are as follows. The $\vec{P}$ vector calculated in this printout is in error by a factor of -1.

X_{14} = 2.45 volts

X_{15} = 2.45 volts

X_{16} = 2.45 volts

X_{17} = 2.45 volts

X_{18} = 2.45 volts

X_{19} = 2.45 volts

X_{20} = 2.45 volts

X_{21} = 2.45 volts

X_{22} = 2.45 volts

X_{23} = 2.45 volts

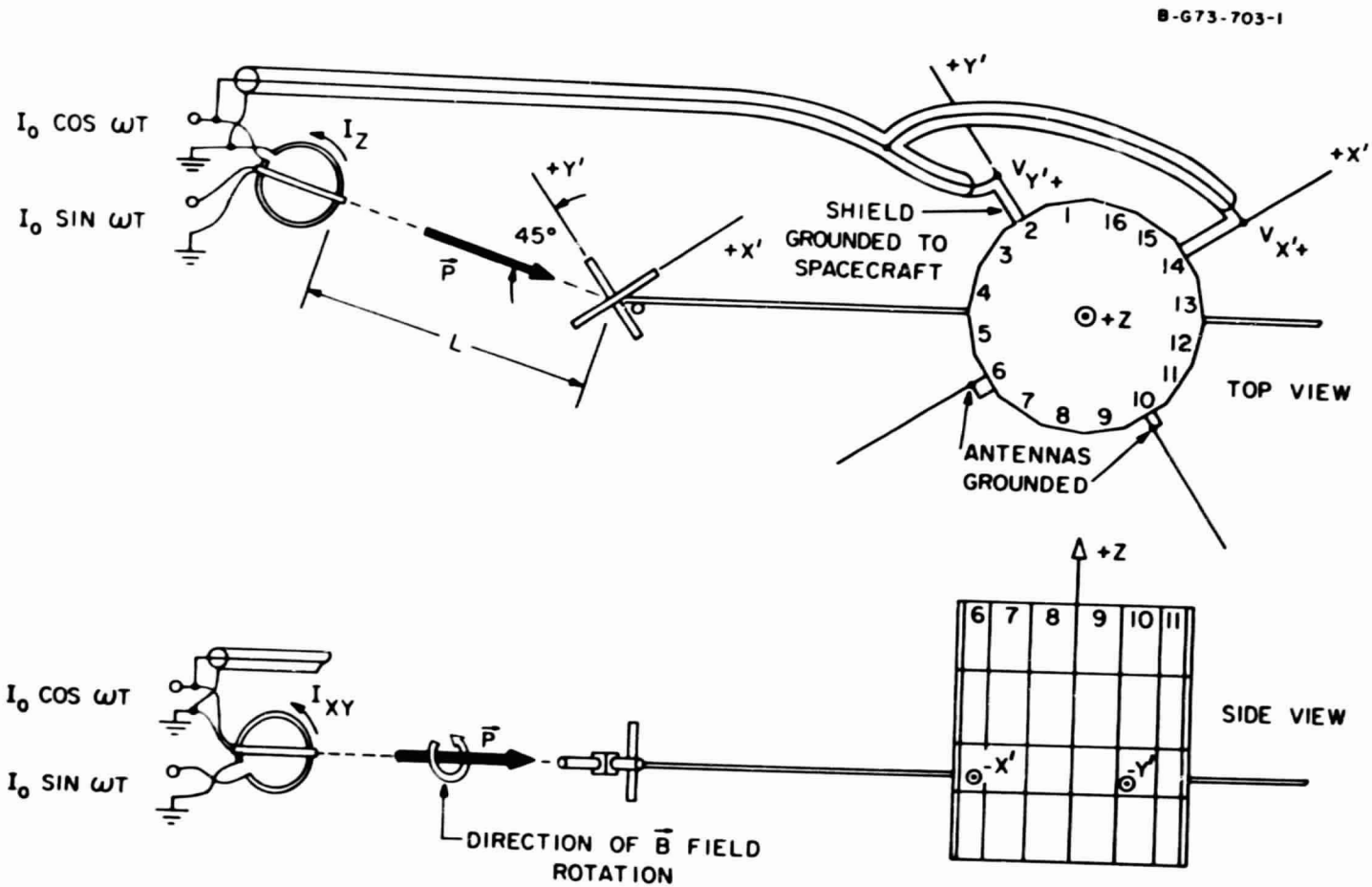

B-G73-703-1
I_0 COS ωT
I_0 SIN ωT
I_Z
+Y'
45°
$\vec{P}$
+X'
L
SHIELD GROUNDED TO SPACECRAFT
$V_{Y'+}$
$V_{X'+}$
+Z
TOP VIEW
ANTENNAS GROUNDED
I_{XY}
DIRECTION OF $\vec{B}$ FIELD ROTATION
-X'
-Y'
SIDE VIEW

Figure 5.5.1

30.6 Hz Run

IMP INTEGRATION IBF MAG CAL, 60 CYCLE OFF. SEP 12 1503 14

IMP-J IBF AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (IBWA - GURNETT) HIGH BIT RATE S/C CLOCK 100057 PG 1 SEP 12 1502 13

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.27	1	5.60		Ex	Ey	Bx	By
1	.100	0.67	1	10.0	0.67		2.52		3.77
2	.178	0.67	1	16.5	0.55		2.52		1.55
3	.311	1.82	1	22	0.77		2.52		2.87
4	.560	2.37	1	31	0.42		2.52		2.60
5	1.00	2.20	1	56	0.42		2.52	3.77	1.77
6	1.78	1.85	1	100	0.50		2.52	1.32	3.52
7	.040	4.07	1	178	0.90		2.52	3.30	1.17
8	.100	1.87	2				2.52	2.20	3.67
9	.178	2.55	2			1.15			1.52
10	.311	2.55	2			1.17			3.15
11	.560	3.20	2			1.17			1.20
12	1.00	3.10	2			1.17			3.82
13	1.78	2.70	2			1.17	2.52	3.02	3.25
	AGC		2			1.17	2.52	1.25	2.52
14		2.85	2			1.17	2.52	3.45	2.10
15		2.82					2.52	1.25	3.00
16		2.82	1	0T		Ex	Ey	Bx	By
17		2.82	1	5T		0.544	0.523	0.693	0.721
18		2.95	1	0T					
19		1.97	1	7T		ANG EX	ANG EY	ANG BX	ANG BY
20		2.97	1	8T		42.7	45.0	-43.9	-44.0
21		1.95	1	9T					
22		1.87						Px	Py
23		1.95						-0.721	0.692

IEF	KHZ	P	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.30	1	5.60	1.05	Ex	Ey	Bx	By
1	.100	0.77	1	10.0	0.67	2.52	2.52	1.55	3.97
2	.178	0.67	1	16.5	0.55	2.52	2.52	2.37	-0.38
3	.311	1.80	1	22	0.77	2.52	2.52	3.20	0.72
4	.560	2.35	1	31	0.42	2.52	2.52	1.57	1.27
5	1.00	2.17	1	56	0.42	2.52	2.52	3.87	2.92
6	1.78	1.80	1	100	0.47	2.52	2.52	1.07	2.42
7	.040	4.12	1	178	0.87	2.52	2.52	3.87	1.52
8	.100	2.05	2		1.17	2.52	2.52	1.42	3.42
9	.178	2.55	2		1.15	2.52	2.52	2.85	1.27
10	.311	2.50	2		1.17	2.52	2.52	2.42	3.47
11	.560	3.15	2		1.15	2.52	2.52	1.70	1.80
12	1.00	3.05	2		1.15	2.52	2.52	3.52	2.92
13	1.78	2.65	2		1.15	2.52	2.52	1.15	2.72
	AGC		2		1.15	2.52	2.52	3.82	1.95
14	0000	2.75	2		1.17	2.52	2.52	3.65	3.20
15	1	2.90				2.52	2.52	1.25	2.50
16		2.72	1	4T		Ex	Ey	Bx	By
17		2.87	1	5T		0.540	0.499	0.804	0.799
18	0000	2.95	1	6T					
19	1	1.82	1	7T	1	ANG EX	ANG EY	ANG BX	ANG BY
20		3.00	1	8T	1	56.2	57.2	-51.6	-46.6
21		1.87	1	9T	1				
22		2.02				AP-41	20.5		Px
23		1.75				AP-12	4.55		-0.713

IMP-J IBF AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (IBWA - GURNETT) HIGH BIT RATE S/C CLOCK 100057 PG 2 SEP 12 1502 28

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.35	1	5.60	1.05	Ex	Ey	Bx	By
1	.100	0.72	1	10.0	0.67	2.52	2.52	1.30	3.52
2	.178	0.65	1	16.5	0.52	2.52	2.52	3.35	1.05
3	.311	1.82	1	22	0.77	2.52	2.52	2.07	3.72
4	.560	2.37	1	31	0.42	2.52	2.52	2.35	1.22
5	1.00	2.22	1	56	0.42	2.52	2.52	3.15	3.15
6	1.78	1.82	1	100	0.47	2.52	2.52	1.37	2.12
7	.040	4.00	1	178	0.90	2.52	2.52	3.82	2.15
8	.100	1.90	2	Ex	1.17	2.52	2.52	1.15	3.12
9	.178	2.57	2	31.1	1.17	2.52	2.52	3.55	1.30
10	.311	2.55	2		1.17	2.52	2.52	1.90	3.57
11	.560	3.20	2		1.17	2.52	2.52	2.50	1.17
12	1.00	3.07	2		1.17	2.52	2.52	3.05	3.45
13	1.78	2.70	2		1.17	2.52	2.52	1.40	1.85
	AGC		2		1.17	2.52	2.52	3.80	2.65
14	0000	2.67	2		1.15	2.52	2.52	1.07	2.92
15	1	2.92				2.52	2.52	3.65	1.57
16	30.6	2.82	1	4T	0	Ex	Ey	Bx	By
17		2.90	1	5T	0	0.518	0.461	0.762	0.832
18	0000	3.17	1	6T	0				
19	1	2.20	1	7T	1	ANG EX	ANG EY	ANG BX	ANG BY
20		3.25	1	8T	1	64.8	69.2	-19.2	-16.1
21		2.22	1	9T	1				
22		2.22						Px	Py
23		1.75						-0.736	0.674

IEF	KHZ	P	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.30	1	5.60	1.05	Ex	Ey	Bx	By
1	.100	0.75	1	10.0	0.67	2.52	2.52	1.65	3.17
2	.178	0.67	1	16.5	0.55	2.52	2.52	3.77	1.27
3	.311	1.80	1	22	0.77	2.52	2.52	1.85	3.67
4	.560	2.35	1	31	0.42	2.52	2.52	3.22	0.90
5	1.00	2.17	1	56	0.42	2.52	2.52	2.65	3.70
6	1.78	1.80	1	100	0.47	2.52	2.52	1.97	1.90
7	.040	4.07	1	178	0.87	2.52	2.52	3.40	2.97
8	.100	2.00	2	Ex	1.15	2.52	2.52	0.97	2.70
9	.178	2.52	2	31.1	1.17	2.52	2.52	3.67	1.95
10	.311	2.50	2		1.15	2.52	2.52	1.10	3.57
11	.560	3.15	2		1.17	2.52	2.52	3.20	1.32
12	1.00	3.05	2		1.15	2.52	2.52	2.12	3.75
13	1.78	2.65	2		1.17	2.52	2.52	2.20	1.30
	AGC		2		1.17	2.52	2.52	3.47	3.32
14	0000	2.57	2		1.17	2.52	2.52	1.35	2.12
15	1	2.95				2.52	2.52	4.05	2.30
16	30.6	2.55	1	4T	0	Ex	Ey	Bx	By
17		2.95	1	5T	0	0.514	0.509	0.724	0.774
18	0000	3.17	1	6T	0				
19	1	2.37	1	7T	1	ANG EX	ANG EY	ANG BX	ANG BY
20		3.22	1	8T	1	76.4	78.6	-6.5	-6.0
21		2.37	1	9T	1				
22		2.40						Px	Py
23		1.67				AP-12	4.85		-0.730

Table 5.5-1

IMP INTEGRATION — IBF MAG CAL, 60 CYCLE REF. — SEP 1 1522 00

IMP-J IBF AC ELECTRIC AND MAGNETIC FIELD EXPERIMENT (IBWA - UHNETT) HIGH BIT RATE S/C CLOCK 100072 DG 3 SEP 12 1517 30

IEF	KHZ	A	SFN	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.37	1	5.60	1.50	EX	EY	BX	BY
1	.100	2.07	1	10.0	1.25	2.52	2.52	1.30	4.37
2	.178	0.81	1	16.5	0.92	2.52	2.52	1.22	0.90
3	.311	0.55	1	22	1.02	2.52	2.52	1.37	3.57
4	.560	1.17	1	31	0.67	2.52	2.52	3.25	1.22
5	1.00	2.50	1	56	0.60	2.52	2.52	1.62	3.70
6	1.78	2.17	1	100	0.55	2.52	2.52	2.95	1.87
7	.090	0.85	1	178	0.92	2.52	2.52	1.90	3.72
8	.100	2.85	2	EX	1.45	2.52	2.52	2.40	1.65
9	.178	2.52	2	31.1	1.45	2.52	2.52	2.10	3.50
10	.311	2.20	2		1.45	2.52	2.52	2.17	1.62
11	.560	2.02	2		1.45	2.52	2.52	2.52	2.87
12	1.00	3.37	2		1.45	2.52	2.52	2.17	2.47
13	1.78	3.05	2		1.45	2.52	2.52	2.82	1.85
	A/C		2		1.45	2.52	2.52	3.11	2.52
14	0000	1.97	2		1.47	2.52	2.52	2.35	1.42
15	1	2.22				2.52	2.52	2.47	2.47
16	61.5	1.97	1141	1		EX	EY	-X	BY
17		2.70	1151	0	0.550	0.561	1.135	1.500	1.522
18	0000	2.57	1161	0					
19	1	3.23	1171	1	ANG EX	ANG EY	ANG -X	ANG BY	ANG BZ
20		2.75	1181	1	150.5	152.4	84.4	78.3	-3.1
21		3.52	1191	1					
22		3.97					PX	PY	PZ
23		2.37					-0.741	0.484	-0.054

IMP-J IBF AC ELECTRIC AND MAGNETIC FIELD EXPERIMENT (IBWA - GUNETT) HIGH BIT RATE S/C CLOCK 100033 DG 0 SEP 12 1618 00

IEF	KHZ	A	SFN	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.52	1	5.60	1.50	EX	EY	BX	BY
1	.100	2.07	1	10.0	1.25	2.52	2.52	2.17	3.27
2	.178	0.77	1	16.5	0.92	2.52	2.52	2.80	1.65
3	.311	0.52	1	22	1.02	2.52	2.52	2.40	3.22
4	.560	1.17	1	31	0.67	2.52	2.52	2.90	1.72
5	1.00	2.50	1	56	0.60	2.52	2.52	1.00	3.05
6	1.78	2.17	1	100	0.55	2.52	2.52	2.10	1.87
7	.090	0.90	1	178	0.92	2.52	2.52	3.20	2.27
8	.100	2.87	2	EX	1.45	2.52	2.52	1.77	2.30
9	.178	2.97	2	31.1	1.47	2.52	2.52	3.30	2.25
10	.311	2.20	2		1.45	2.52	2.52	1.60	2.90
11	.560	2.00	2		1.45	2.52	2.52	3.32	1.82
12	1.00	3.37	2		1.47	2.52	2.52	1.45	3.27
13	1.78	3.05	2		1.45	2.52	2.52	2.55	1.60
	A/C		2		1.47	2.52	2.52	1.90	3.45
14	0000	2.67	2		1.47	2.52	2.52	3.72	1.82
15	1	1.97				2.52	2.52	1.35	3.45
16	61.5	2.20	1141	1		EX	-X	BY	BZ
17		1.95	1151	0	0.528	0.559	1.118	1.124	1.504
18	0000	1.45	1161	0					
19	1	1.95	1171	1	ANG EX	ANG EY	ANG -X	ANG BY	ANG BZ
20		1.57	1181	1	-65.9	-64.5	-153.5	-161.4	125.7
21		1.75	1191	1					
22		1.52					BX	BY	BZ
23		3.67					-0.729	0.696	0.107

IEF	KHZ	A	SFN	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	3.45	1	5.60	1.50	EX	EY	BX	BY
1	.100	2.35	1	10.0	1.25	2.52	2.52	2.85	3.05
2	.178	.47	1	16.5	0.92	2.52	2.52	2.12	2.47
3	.311	.84	1	22	1.02	2.52	2.52	2.83	2.93
4	.561	1.17	1	31	0.67	2.52	2.52	1.80	2.95
5	1.00	.83	1	56	0.60	2.52	2.52	3.23	2.26
6	1.78	.13	1	100	0.55	2.52	2.52	1.82	2.82
7	.090	.83	1	178	0.92	2.52	2.52	3.48	2.12
8	.100	.90	2	EX	1.45	2.52	2.52	1.27	2.87
9	.178	.52	2	31.1	1.45	2.52	2.52	3.28	2.45
10	.311	.20	2		1.47	2.52	2.52	1.20	3.47
11	.561	.04	2		1.45	2.52	2.52	3.47	1.96
12	1.00	.33	2		1.45	2.52	2.52	1.30	3.67
13	1.78	.00	2		1.45	2.52	2.52	2.45	0.93
	A/C		2		1.45	2.52	2.52	1.40	3.85
14	0000	.95	2		1.43	2.52	2.52	3.63	1.32
15	1	.45				2.52	2.52	1.60	4.25
16	61.5	.25	1141	1		EX	EY	BX	BY
17		.45	1151	0	0.534	0.538	1.301	1.431	1.619
18	0000	2.52	1161	0					
19	1	1.75	1171	1	ANG EX	ANG EY	ANG BX	ANG BY	ANG BZ
20		.27	1181	1	158.1	158.1	84.8	87.2	8.8
21		1.87	1191	1					
22		.05					BX	BY	BZ
23		2.70					-0.742	0.661	.134

Table 5.5-2

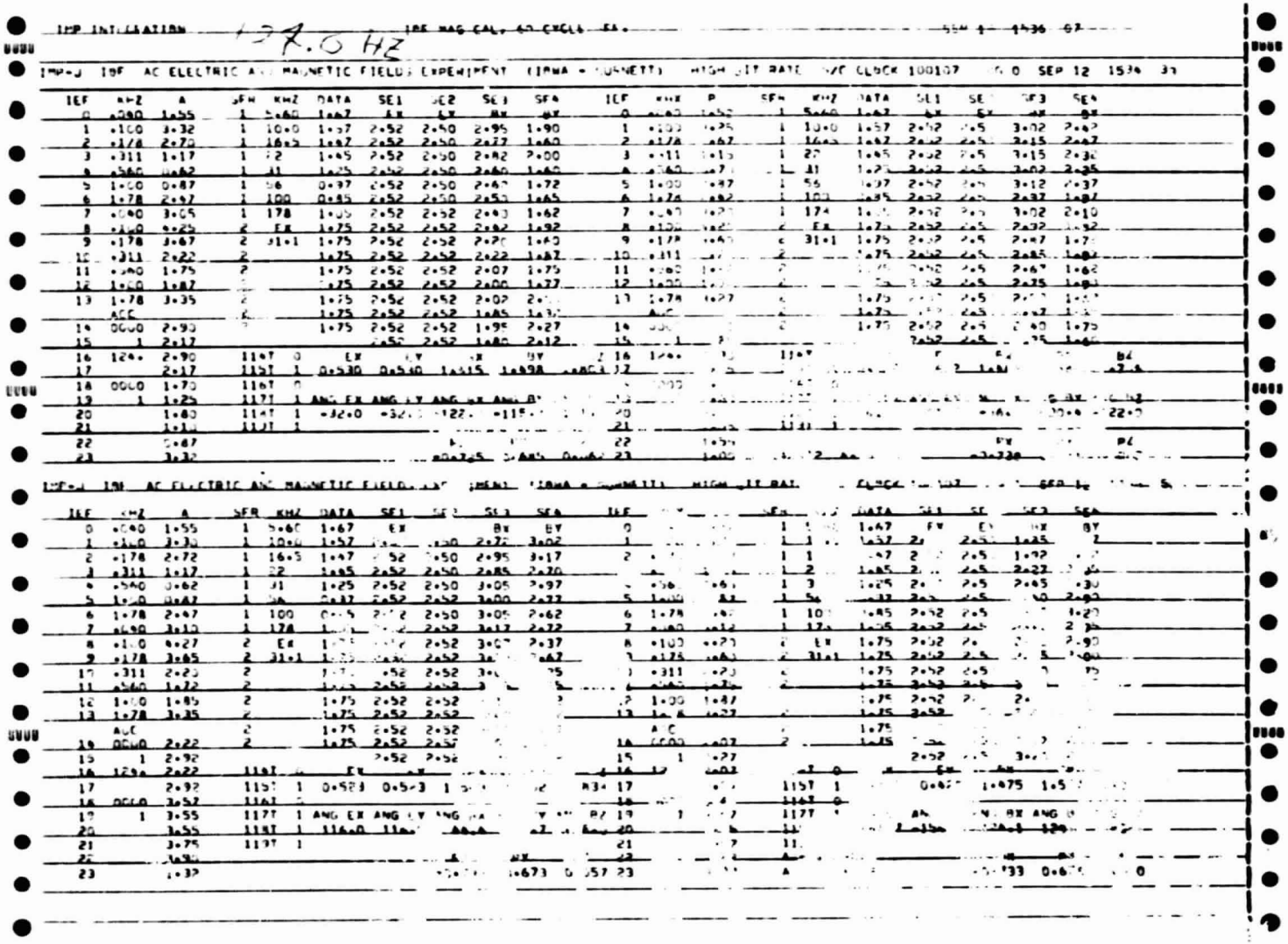


Table 5.5-3

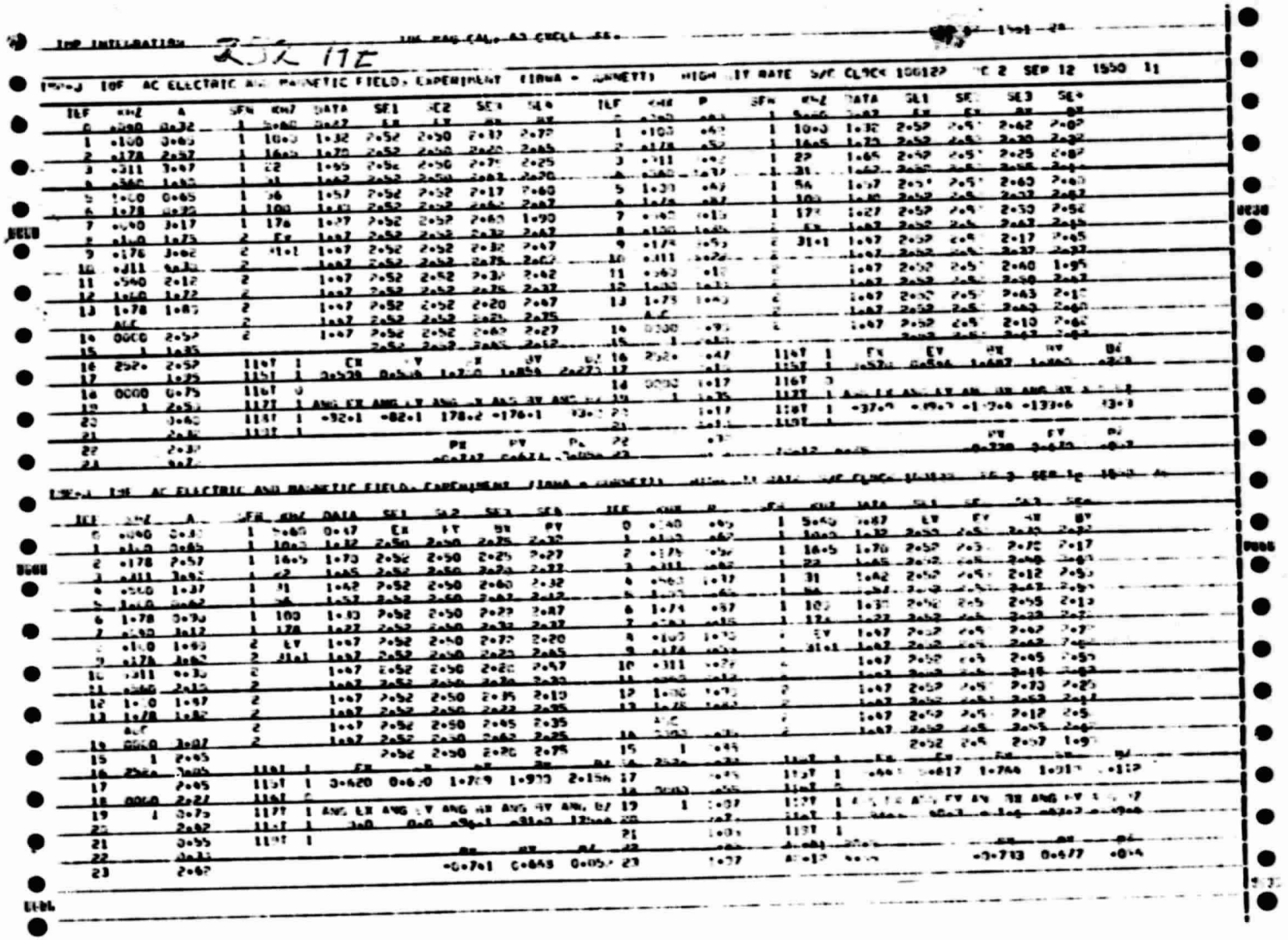


Table 5.5-4

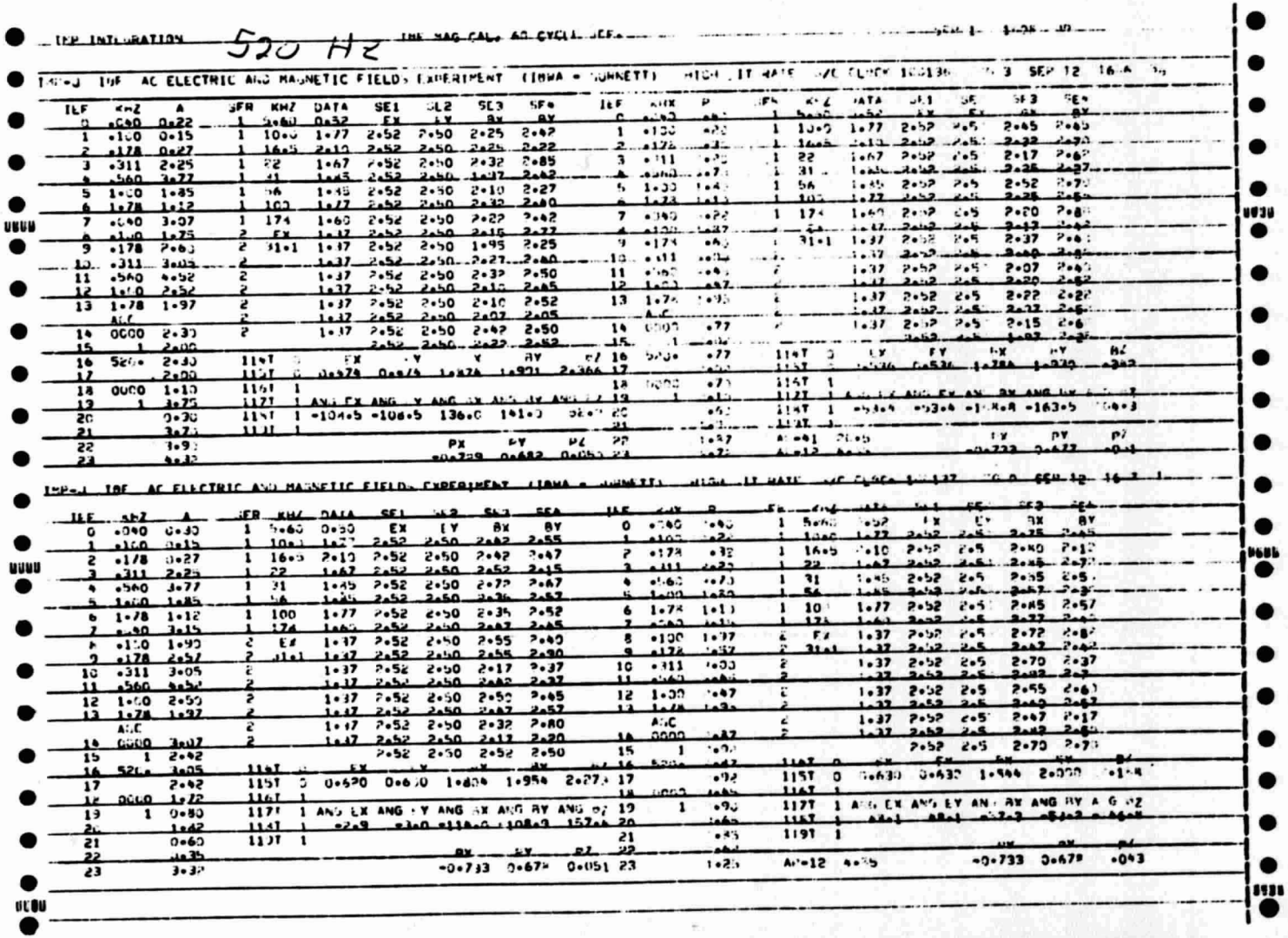


Table 5.5-5

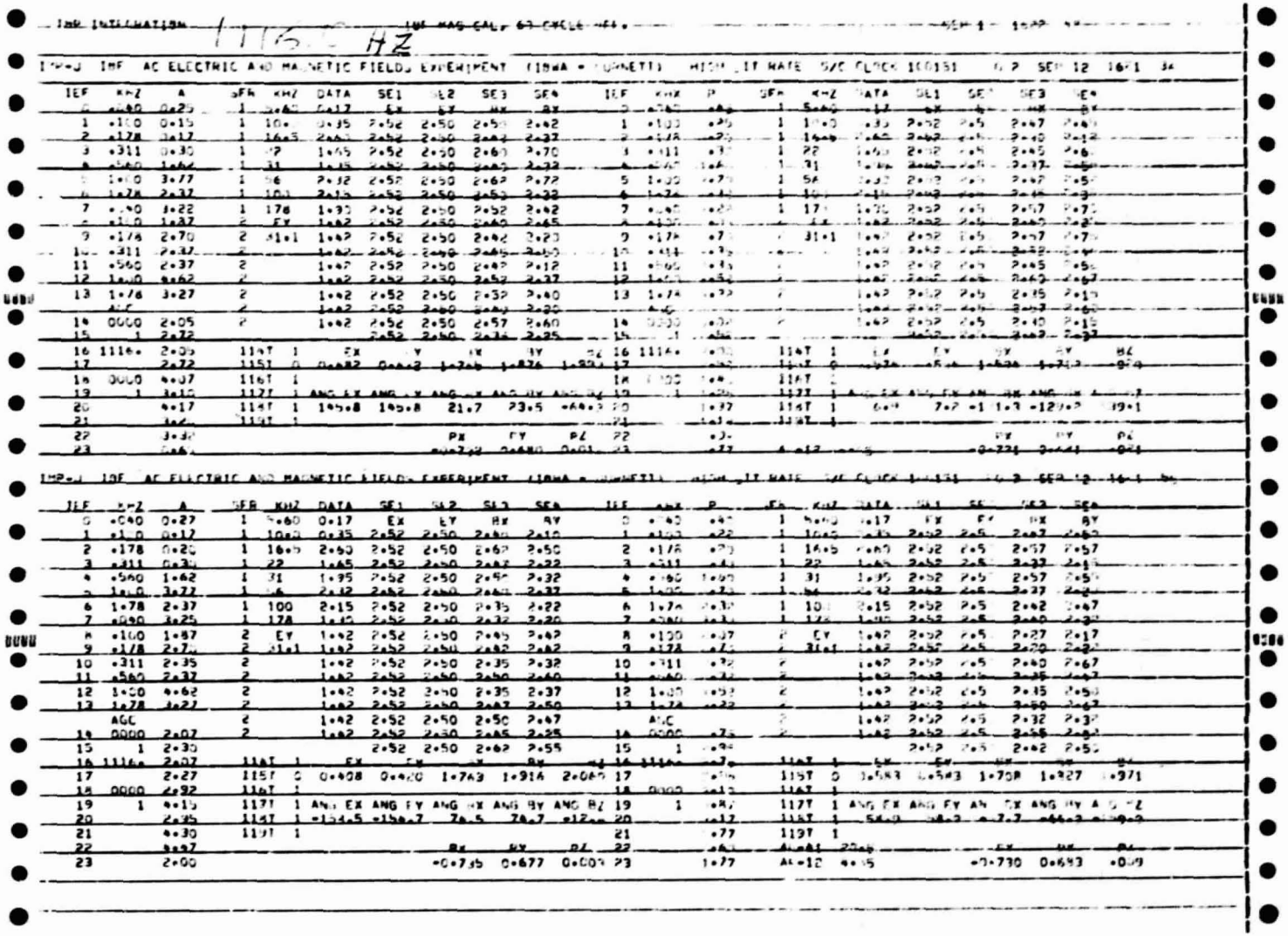


Table 5.5-6

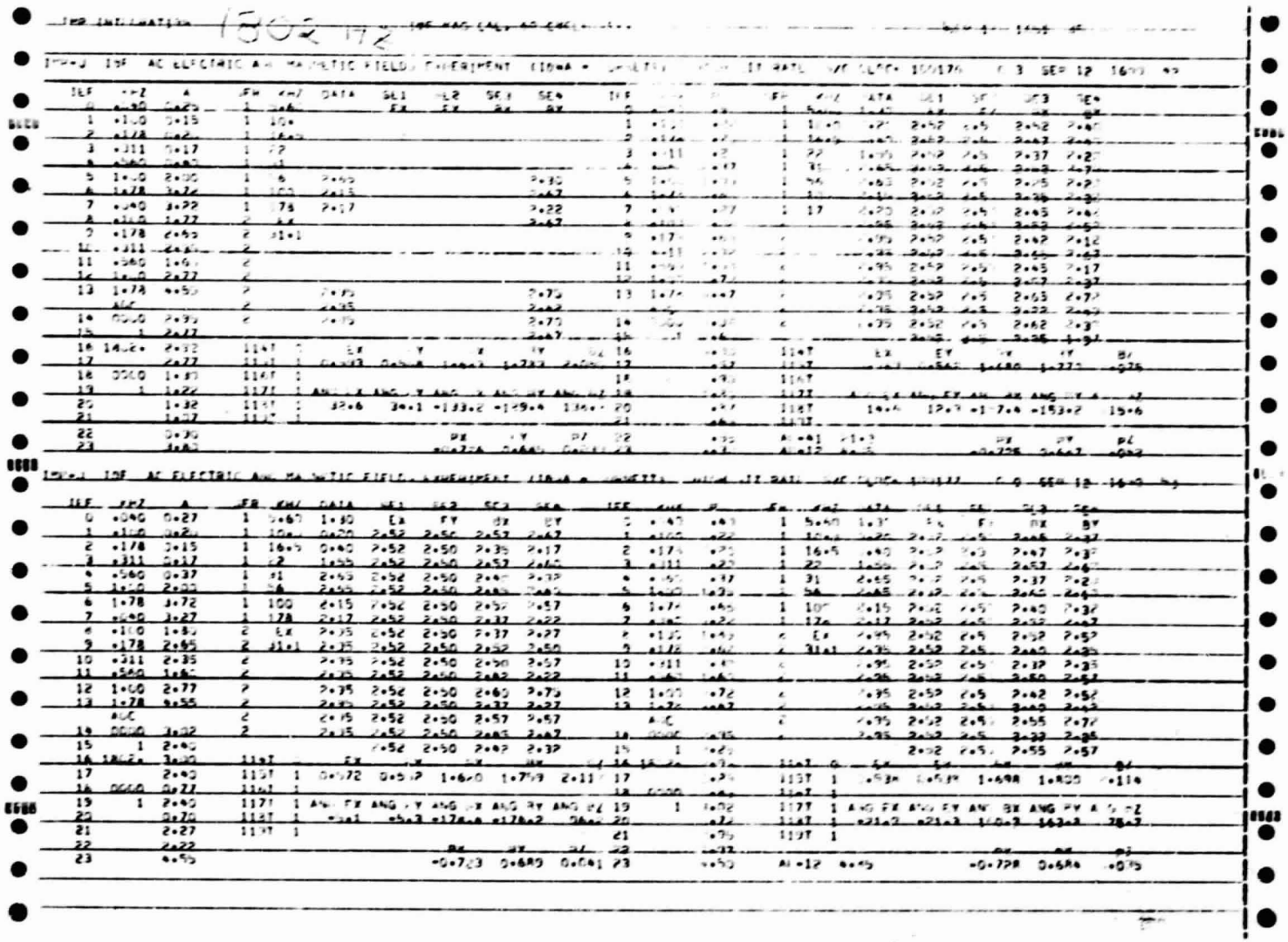


Table 5.5-7

IMP INTEGRATION 2604 Hz (SEE MAG CAL, AC EXCLU DEC.

IMP-J 19F AC ELECTRIC AND MAGNETIC FIELDS EXPERIMENT (IBWA - HORNETT) HIGH BIT RATE S/C CLOCK 105216 DG 1 SEP 12 1711 47

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	[illegible]	[illegible]	1	[illegible]		Ex	Ey	Bx	By
1	.100	0.15	1	10.0					
2	.178	[illegible]	1	16.5					
3	.311	0.20	1	22	0.65				
4	.560	[illegible]	1	31	1.AC				
5	1.00	0.A2	1	56	1.55			2.50	2.10
6	1.78	2.65	1	100	2.07			2.75	2.A7
7	[illegible]	3.22	1	178	2.52			2.40	2.30
8	.160	1.77	2					2.50	2.A0
9	.178	2.60	2						
10	.311	2.25	2						
11	.560	1.50	2		0.90				
12	1.00	1.A2	2		0.92				
13	1.78	3.42	2		0.47		2.50	2.50	2.40
	A&C		2		0.A3		2.50	2.52	2.A5
14		2.17	2		0.47		2.50	2.50	2.22
15		2.30					2.50	2.32	2.55
16		2.17	114T			Ex	Ey	Hx	Hy
17		2.A7	115T			0.530	0.5.8	1.397	1.A61
18		2.67	116T						
19		1.37	117T			ANG Ex	ANG Ey	ANG Hx	ANG Hy
20		2.75	118T			121.8	123.6	-81.0	-78.3
21		1.42	119T						
22		0.47						Px	Py
23		2.22						[illegible]	0.A91

IEF	KHZ	A	SFR	KHZ	DATA	SE1	SE2	SE3	SE4
0	.040	0.27	1	.060	1.03	Ex	Ey	Bx	By
1	.100	0.15	1	10.0	0.27	2.52	2.50	2.55	2.37
2	.178	0.17	1	16.5	0.32	2.52	2.50	2.37	2.22
3	.311	0.17	1	22	0.65	2.52	2.50	2.45	2.30
4	.560	0.17	1	31	1.03	2.52	2.50	2.30	2.25
5	1.00	0.A2	1	56	1.55	2.52	2.50	2.A7	2.22
6	1.78	2.65	1	100	2.07	2.52	2.50	2.30	2.27
7	.040	3.27	1	178	2.42	2.52	2.50	2.A7	2.A5
8	.100	1.92	2	EY	0.92	2.52	2.50	2.40	2.00
9	.178	2.57	2	31.1	0.A0	2.52	2.50	2.45	2.47
10	.311	2.25	2		0.40	2.52	2.50	2.40	2.35
11	.560	1.97	2		0.A7	2.52	2.50	2.27	2.35
12	1.00	1.62	2		0.30	2.52	2.50	2.40	2.45
13	1.78	3.42	2		0.A7	2.52	2.50	2.32	1.90
	A&C		2		0.30	2.52	2.50	2.50	2.60
14	0.40	2.A3	2		0.A7	2.52	2.50	2.56	2.A0
15	1	2.02				2.52	2.50	2.35	2.35
16	24.8A	2.A3	116T	1		Ex	Ey	Hx	Hy
17		2.02	115T	1		0.432	0.442	1.500	1.569
18	0.40	4.55	116T	1					
19	1	3.47	117T	1	ANG Ex	ANG Ey	ANG Hx	ANG Hy	ANG Pz
20		3.55	118T	1	-78.7	-96.2	8.2.8	85.8	-84.7
21		3.57	119T	1					
22		3.72						Bx	By
23		1.30						-0.713	0.649

Table 5.5-8

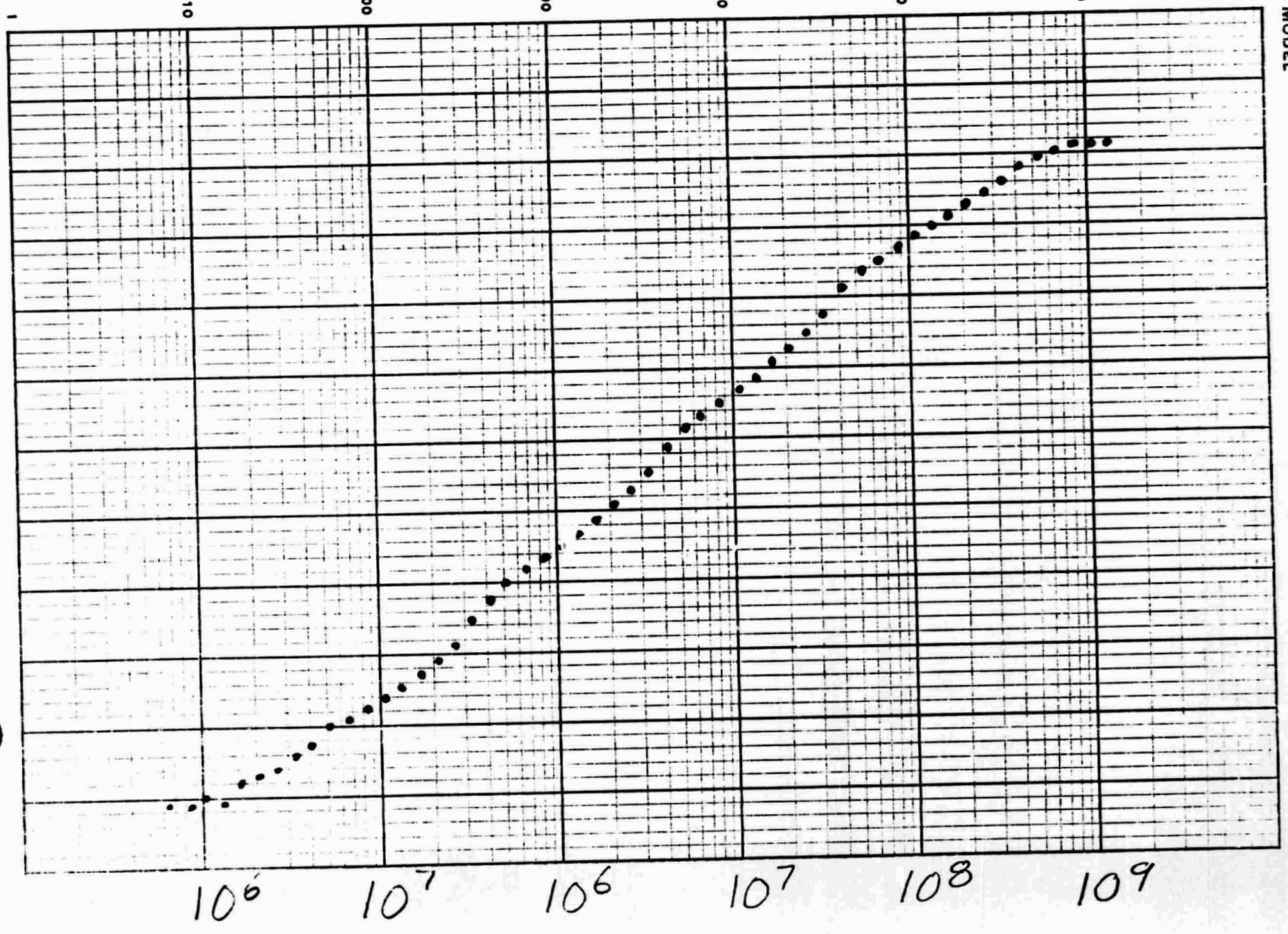
5.7 Impedance Measurement Calibration

The impedance measurement was calibrated by mounting known resistive terminations on the +X and -X antennas test input terminals and reading the peak output from the IEF-0 (40 Hz) spectrum analyzer channel. The calibrated impedance values and the corresponding outputs are listed below.

Z	IEF-0 Output
0.999 Meg	2.20 volts
9.90 Meg	3.27 volts
90.9 Meg	3.81 volts
476 Meg	3.87 volts
999 Meg	3.88 volts

The 0.999 and 9.90 Meg calibrations were then used to replot the IEF-0 calibration curve in terms of impedance, assuming that the input voltage for this channel is proportional to the impedance. The resulting impedance calibration curve is shown in Figure 5.7-1.

K&E SEMI-LOGARITHMIC 46 6460
7 CYCLES X 60 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.



5.7 1

Imp ce

6.0 DECOM TAPE FORMAT

WORD NO.	DESCRIPTION		
Note: Each 8 bit App is right justified in a 9 bit field, and reads as an integer count.			
111		DPP A2	5-8
112			9-12
113			13-16
114			17-20
115			21-24
116			25-28
117			29-32
118			33-36
119		DPP A3	1-8
120			9-16
121			17-24
Note: Refer to explanatory note 'DPP's'. Each 8 bit group of 4 DPP's is right justified in a 9 bit field.			
122	Bits 0-8	EDP 1-4	Seq. 0
	9-17		Seq. 1
	18-26		Seq. 2
	27-35		Seq. 3
123	0-8		Seq. 4
	9-17		Seq. 5
.			.
.			.
.			.
125	Bits 27-35		Seq. 15
Note: EDP's 1-4 are given as 000004321 in a 9 bit field.			
126		Optical Aspect 12 bit scan	
127		Optical Aspect 20 bit scan	
128	Bits 0-17	Optical Aspect Sun Time Count	
	18-35	Optical Aspect Spin Pd. Count	
129	Bits 0-17	Optical Aspect Earth In Count	
	18-35	Optical Aspect Earth Width Count	

C. Experiment Data, Page 0.

Each 8 bit data value appears right justified in 18 bit field.

WORD NO.	DESCRIPTION
130	Bits 0-17 SFR1 Seq. 0
	18-35 SFR1 Seq. 1
131	0-17 SFR1 Seq. 2
	18-35 SFR1 Seq. 3
132	Bits 0-17 SFR1 Seq. 4
	18-35 SFR1 Seq. 5
.	. . .
.	. . .
.	. . .
137	0-17 SFR1 Seq. 14
	18-35 SFR1 Seq. 15
138	Bits 0-17 SFR2 Seq. 0
	18-35 SFR2 Seq. 1
.	. . .
.	. . .
.	. . .
145	0-17 SFR2 Seq. 14
	18-35 SFR2 Seq. 15
146-149	IEF 0-7, Seq. 5, SS1
150-153	IEF 8-15, Seq. 6, SS1
154-157	IEF 16-23, Seq. 7, SS1
158-161	IEF 0-7, Seq. 13, SS3
162-165	IEF 8-15, Seq. 14, SS3
166-169	IEF 16-23, Seq. 15, SS3
170-173	IEF Se-1, 1-8, Seq. 0, SS0
174-177	IEF Se-1, 9-16, Seq. 1, SS0
178-181	IEF Se-1, 1-8, Seq. 8, SS2
182-185	IEF Se-1, 9-16, Seq. 9, SS2
186-189	IEF Se-2, 1-8, Seq. 2, SS0

WORD NO.	DESCRIPTION
190-193	IEF Se-2, 9-16, Seq. 0, SS0 and Seq. 4, SS1
194-197	IEF Se-2, 1-8, Seq. 10, SS2
198-201	IEF Se-2, 9-16, Seq. 8, SS2 and Seq. 12, SS3
202-209	IEF Se-3, 1-16, Seq. 1, SS0 and Seq. 5, SS1
210-217	IEF Se-3, 1-16, Seq. 9, SS2 and Seq. 13, SS3
218-225	IEF Se-4, 1-16, Seq. 3, SS0 and Seq. 7, SS1
226-233	IEF Se-4, 1-16, Seq. 11, SS2 and Seq. 15, SS3
234-387	Parts B & C for Page 1
388-541	Parts B & C for Page 2
542-695	Parts B & C for Page 3

695 36-Bit Words

4/19/72

IMP-H, J DECOM TAPE
EXPLANATORY NOTE

EXP. NO. - EXPERIMENTER -

Quality Flags

Time and data quality flags are 2 bit integers as follows:

Value	Time Quality	Data Quality
0	Analog time unverified	Excellent (PE less than 10^{-6})
1	Analog time verified by S/C clock	Good (PE less than 10^{-4})
2	Analog time in error-S/C clock used	Fill
3	Time put with fill data-computed	Undetermined

Time Quality Flags occur one per sequence (2 bits per sequence) and appear in the following order on the decom tape:

Seq 0 (2 bits)
Seq 1 "
. "
. "
. "
Seq 15 "

Data Quality Flags may appear either one per sequence or flags appear on the decom tape as follows:

One Per Seq

Seq 0 (2 bits)
Seq 1 "
⋮ "
Seq 15 "

Quality flags are supplied only when requested.

Fill occurs on a whole sequence basis - all fill or none.

4/19/72

IMP-H, J DECOM TAPE

EXPLANATORY NOTE

EXP. NO. - EXPERIMENTER -

Fill Data and Continuity Flags

Fill Data

Missing data will appear as zero unless otherwise agreed upon. A telemetry sequence will contain all fill or none. Fill sequences have no clock or pseudo sequence counter.

If album format (first page of record is always page 0) has been requested, there may be whole pages of fill in the case of large data dropouts and at end-of-files. No record (tape block) will be written with all fill, though as little as one sequence of data could be written. Note that if page 0 is missing, there will be no start-of-page time at the beginning of the record.

Continuity Flags

2^0 = 0, no fill data in page.
2^1 = 0, no time discontinuity following.

4/19/72

IMP-H, J DECOM TAPE
EXPLANATORY NOTE

EXP. NO. - EXPERIMENTER -

Space Craft Clock

The spacecraft clock appears as an integer, of which the least significant bit (2^0) counts at the sequence rate. The main frame count and data rate bits have been dropped. All complementation, bit reversal and rearrangement has been done.

Thus, bits $2^1 2^0$ = Telemetry sequence
$2^3 2^2$ = Telemetry snapshot
$2^5 2^4$ = Telemetry page
$2^7 2^6$ = Telemetry album

In the case of low bit rate, redundant bits (a_5 a_6) have been removed so that the clock counts normally.

The clock value has been time corrected where necessary and possible.

4/19/72

IMP-H, J DECOM TAPE
EXPLANATORY NOTE

EXP. NO. - EXPERIMENTER -

DPP's (Digital Performance Parameters)

All DPP's from each page are supplied.

DPP's A2 occur once per snapshot for a total of 4 each per page.

DPP's A3 occur once per 2 snapshots for a total of 2 each per page.

Each group of 8 significant bits represents 4 DPP's as follows:

$D_4D_3D_2D_1D_4D_3D_2D_1$

Thus for DPP A2, 5-8: D_4 = DPP 8, D_3 = DPP7, D_2 = DPP6, D_1 = DPP5.

DPP's appear on the decom in the following order:

A2, 5-8,	S.S. ø	(8 Bits)
" "	S.S. 1	"
" "	S.S. 2	"
" "	S.S. 3	"
A2, 9-12,	S.S. ø	"
" "	S.S. 1	"
" "	S.S. 2	"
" "	S.S. 3	"
A2, 13-16,	S.S. 0	"
" "	S.S. 1	"
" "	S.S. 2	"
" "	S.S. 3	"
.	.	"
.	.	"
.	.	"
A2, 33-36,	S.S. ø	"
" "	S.S. 1	"
" "	S.S. 2	"
" "	S.S. 3	"

A3, 1-4,	S.S. ø	(8 Bits,
" "	S.S. 2	"
A3, 5-8	S.S. ø	"
" "	S.S. 2	"
A3, 9-12,	S.S. 1	"
" "	S.S. 3	"
A3, 13-16,	S.S. ø	"
" "	S.S. 2	"
A3, 17-20	S.S. 1	"
" "	S.S. 3	"
A3, 21-24	S.S. ø	"
" "	S.S. 2	

As an example, DPP A2, No. 33, from S.S. ø, would be either of the D_1 bits from the first 8 bit group for DPP A2, 33-36.

4/19/72

IMP-H, J DECOM TAPE

EXPLANATORY NOTE

EXP. NO. - EXPERIMENTER -

APP's (Analog Performance Parameters)

Each APP appears as an integer representing count values from ø to 255.

APP's 16, 1-15 appear every page.
APP's 48, 17-31 appear only on even pages (page 0 and page 2 as determined by the clock).

APP's 32-47 appear only on odd pages (1 and 3).

The first 16 APP's on the decom tape are APP's 16, 1-15, in that order. The next 16 APP's are either 48, 17-31, or 32-47, in those orders, depending on the page number.

ATTACHMENT

ATTITUDE/ORBIT/EPHEMERIS TAPE FORMAT

All words are 36 bits long, UNIVAC 1108 FLTNG PT.

WORD NO.	FORM	IDENTIFICATION
1	Floating Pt.	Day of year } time of orbit data
2	" "	Milliseconds of day } in this record
3	" "	Longitude (deg.) } satellite position in
4	" "	Latitude (deg.) } geocentric coordinates
5	" "	Longitude (deg.) } satellite position in
6	" "	Latitude (deg.) } geomagnetic coordinates
7	" "	R (earth radii) a geomagnetic coordinate of the satellite position, C.U.L.
8	" "	r, radial distance of the satellite from the center of the earth (km.)
9	" "	GSE X } Satellite position in Geocentric Solar
10	" "	GSE Y } Ecliptic Coordinates (km.)
11	" "	GSE Z }
12	" "	GSM X } Satellite position in Geocentric Solar
13	" "	GSM Y } Magnetospheric Coordinates (km.)
14	" "	GSM Z }
15	" "	GSE X } Moon position in Geocentric Solar
16	" "	GSE Y } Ecliptic Coordinates (km.)
17	" "	GSE Z }
18	" "	GSM X } Moon position in Geocentric Solar
19	" "	GSM Y } Magnetospheric Coordinates (km.)
20	" "	GSM Z }

WORD NO.	FORM	IDENTIFICATION
21	Floating Pt.	GEI X } Satellite position in Geocentric
22	" "	GEI Y } Equatorial Inertial (km.)
23	" "	GEI Z }
24	" "	GEI X } Sun position in Geocentric Equatorial
25	" "	GEI Y } Inertial (A.U.)
26	" "	GEI Z }
27	" "	Longitude } Sub-solar point in geomagnetic
28	" "	Latitude } coordinates (deg.)
29	" "	Distance from the satellite to the Moon (km.)
30	" "	Distance parallel to the x-axis from the satellite to the moon (km.)
31	" "	1st row, 1st column } Geocentric Solar Ecliptic to Geocentric Solar Magnetospheric transformation matrix.
32	" "	1st row, 2nd column
33	" "	1st row, 3rd column
34	" "	2nd row, 1st column
35	" "	2nd row, 3rd column
36	" "	2nd row, 3rd column
37	" "	3rd row, 1st column
38	" "	3rd row, 2nd column
39	" "	3rd row, 3rd column
40	" "	1st row, 1st column } Geocentric Equatorial Inertial-to-Geocentric Solar Ecliptic transformation matrix.
41	" "	1st row, 2nd column
42	" "	1st row, 3rd column
43	" "	2nd row, 1st column
44	" "	2nd row, 2nd column
45	" "	2nd row, 3rd column
46	" "	3rd row, 1st column
47	" "	3rd row, 2nd column
48	" "	3rd row, 3rd column

WORD NO.	FORM	IDENTIFICATION
49	Floating Pt.	Right Ascension } Satellite position in
50	" "	Declination } celestial inertial (deg.)
51	" "	Right Ascension } Velocity vector in
52	" "	Declination } celestial inertial (deg.)
53	" "	Magnitude of the velocity (km./sec.)
54	" "	L McIlwain parameter (earth radii)
55	" "	B Magnetic field strength (Gamma)
56	" "	B/B_o Ratio of the magnetic field strength at the satellite-to-the-field strength at the invarient equator
57	" "	Satellite-earth-sun- angle, Lsep (deg.)
58	" "	Satellite-earth-moon angle (deg.)
59	" "	Right ascension } Magnetic vector in
60	" "	Declination } celestial inertial (deg.)
61	" "	Longitude } Sub-solar point in (deg.)
62	" "	Latitude } Geocentric Equatorial Inertial
63	" "	GSE X } Theoretical geomagnetic field in
64	" "	GSE Y } Geocentric Solar Ecliptic coordinates
65	" "	GSE Z } (in gamma)
66	" "	Type of data item indicator: 1 = regular satellite data item 2 = ascending node crossing data item 3 = North point data item 4 = descending node data item 5 = south point data item 6 = sunlight entrance data item 7 = sunlight exit data item
67	" "	Date of data (YR MO DA)

WORD NO.	FORM	IDENTIFICATION
68	Floating Pt.	Longitude } Geodetic satellite position (deg.)
69	" "	Latitude }
70	" "	Height above spheroid (km.)
71	" "	Ascending node crossing number (pass number)
72	" "	Year of data (YR)
73-75	" "	Zero fill for spares
76	" "	Delta time between time of Ephemeris item and next previous sun pulse which stopped OA - ST Counter (Seconds).
77	" "	Spin period (Seconds)
78	" "	Right Ascension } Spin vector in celestial
79	" "	Declination } inertial (Deg.)

Notes:

Longitude is positive east of Greenwich and negative west of Greenwich (-180° to + 180°)
North latitude is positive and south latitude is negative (-90° to +90°)
Date of data (word number 67) equals day + 100 (months + year (100)). Example: February 10, 1967 at 2 hours U.T. is recorded as 670210 in word 67, 41 in day count (word 1), 7200000 in milliseconds of day (word 2), and 67 in year of data (word 72).

COMPRESSED DATA FILE

Revised 8/29/74

WORD #		
1-158	Orbit/attitude/ephemeris data (79 double length words)	
159	Local Time	
160	Local Magnetic Time	
161	Day of Start of Average	
162-163	Milliseconds of day above	
164	S/C clock for start of Average	
165	DP2-7	Command Status at Start of Average (Status of all 6 commands)
166	DP2-31	
167	DP2-32	
168	DP3-19	OA/TM Slave
169	DP2-8	Analog Trans. On/Off
170	AP39	Antenna length +Y'
171	AP47	Antenna length -Y'
172	Mag LAT	
173	SMLAT	
174	IEF 0 (Ave) Average over 8 pages	
175	IEF0 (Peak) Average over 8 pages	
176	IEF 1 (Ave) Average over 8 pages	
177	IEF 1 (Peak) Average over 8 pages	
178	IEF 2 (Ave) Average over 8 pages	
179	IEF 2 (Peak) Average over 8 pages	
180	IEF 3 (Ave) Average over 8 pages	
181	IEF 3 (Peak) Average over 8 pages	

WORD #	
182	IEF 4 (Ave) Average over 8 pages
183	IEF 4 (Peak) Average over 8 pages
184	IEF 5 (Ave) Average over 8 pages
185	IEF 5 (Peak) Average over 8 pages
186	IEF 6 (Ave) Average over 8 pages
187	IEF 6 (Peak) Average over 8 pages
188	IEF 7 (Ave) Average over 8 pages
189	IEF 7 (Peak) Average over 8 pages
190	IEF 8 (Ave) Average over 8 pages
191	IEF 8 (Peak) Average over 8 pages
192	IEF 9 (Ave) Average over 8 pages
193	IEF 9 (Peak) Average over 8 pages
194	IEF 10 (Ave) Average over 8 pages
195	IEF 10 (Peak) Average over 8 pages
196	IEF 11 (Ave) Average over 8 pages
197	IEF 11 (Peak) Average over 8 pages
198	IEF 12 (Ave) Average over 8 pages
199	IEF 12 (Peak) Average over 8 pages
200	IEF 13 (Ave) Average over 8 pages
201	IEF 13 (Peak) Average over 8 pages
202	Spin Modulation data IEF 0 (Ave)
203	
204	
205	

WORD #	
206	Spin Modulation data IEF 1 (Ave)
207	
208	
209	
210	Spin Modulation data IEF 2 (Ave)
211	
212	
213	
214	Spin Modulation data IEF 3 (Ave)
215	
216	
217	
218	Spin Modulation data IEF 4 (Ave)
219	
220	
221	
222	Spin Modulation data IEF 5 (Ave)
223	
224	
225	
226	Spin Modulation data IEF 6 (Ave)
227	
228	
229	

WORD #	
230	Spin Modulation data IEF 7 (Ave)
231	
232	
233	
234	Spin Modulation data IEF 8 (Ave)
235	
236	
237	
238	Spin Modulation data IEF 9 (Ave)
239	
240	
241	
242	Spin Modulation data IEF 10 (Ave)
243	
244	
245	
246	Spin Modulation Data IEF 11 (Ave)
247	
248	
249	
250	Spin Modulation data IEF 12 (Ave)
251	
252	
253	

WORD #	
254 255 256 257	Spin Modulation data IEF 13 (Ave)
258 259 260	Magnitude, angle, σ SE-2 Average over 8 pages
261 262 263	Magnitude, angle, σ SE-3 Average over 8 pages
264 265 266	Magnitude, angle, σ SE-4 Average over 8 pages
267	SE-2 (1) from first snapshot with good data
268	SE-2 (2) from first snapshot with good data
269	SE-2 (3) from first snapshot with good data
270	SE-2 (4) from first snapshot with good data
271	SE-2 (5) from first snapshot with good data
272	SE-2 (6) from first snapshot with good data
273	SE-2 (7) from first snapshot with good data
274	SE-2 (8) from first snapshot with good data
275	SE-2 (9) from first snapshot with good data
276	SE-2 (10) from first snapshot with good data
277	SE-2 (11) from first snapshot with good data
278	SE-2 (12) from first snapshot with good data

WORD #	
279	SE-2 (13) from first snapshot with good data
280	SE-2 (14) from first snapshot with good data
281	SE-2 (15) from first snapshot with good data
282	SE-2 (16) from first snapshot with good data
283	Spacecraft clock for snapshot during which Se samples were obtained
284	WBR Average over 8 pages } do not compute WBR data if command change in record
285	WBR Peak Value of 8 pages }
286	Flipper Status: 2 = Interference Mode, 1 = Non-Interference Mode, 0 = Can't tell
287	Spare
288	Spare
289	SPF 5.6 kHz Average of 8 pages
290	SPF 5.6 kHz Peak of 8 pages
291	SPF 10.0 kHz Ave of 8 pages
292	SPF 10.0 kHz Peak of 8 pages
293	SPF 16.5 kHz Ave of 8 pages
294	SPF 16.5 kHz Peak of 8 pages
295	SPF 22.0 kHz Ave of 8 pages
296	SPF 22.0 kHz Peak of 8 pages
297	SPF 31.0 kHz Ave of 8 pages
298	SPF 31.0 kHz Peak of 8 pages
299	SPF 56.0 kHz Ave of 8 pages
300	SPF 56.0 kHz Peak of 8 pages
301	SPF 100 kHz Ave of 8 pages
302	SPF 100 kHz Peak of 8 pages

WORD #	
303	SPF 178 kHz Ave of 8 pages
304	SPF 178 kHz Peak of 8 pages
305 306 307 308	Spin Modulation data WB
309 310 311 312	Spin Modulation data 5.6 kHz
313 314 315 316	Spin Modulation data 10 kHz
317 318 319 320	Spin Modulation data 16.5 kHz
321 322 323 324	Spin Modulation data 22 kHz
325 326 327 328	Spin Modulation data 31.1 kHz

WORD #	
329	Spin Modulation data 56.0 kHz
330	
331	
332	
333	Spin Modulation data 100 kHz
334	
335	
336	
337	Spin Modulation data 178 kHz
338	
339	
340	
341	Number of samples in IEF0 Ave, Peak, and IEF 1 Ave, Peak*
342	" " IEF2 Ave, Peak, and IEF 3 Ave, Peak**
343	" " IEF 4 Ave, Peak, and IEF 5 Ave, Peak**
344	" " IEF 6 Ave, Peak, and IEF 7 Ave, Peak**
345	" " IEF 8 Ave, Peak, and IEF 9 Ave, Peak**
346	" " IEF 10 Ave, Peak, and IEF 11 Ave, Peak**
347	" " IEF 12 Ave, Peak, and IEF 13 Ave, Peak**

*Note

Value = # samples (IEF0 Ave) * 1000 + # samples (IEF0 peak) *100 +

samples (IEF1 Ave) 10 + # samples (IEF1 peak)

**Note: These words are formatted like word 341.

WORD #	
348	Number of sample 5.6 kHz * 100 + number of samples 10 kHz SPF
349	Number of sample 16 kHz + number samples 22 kHz SPF
350	Number of samples 31.1 kHz + number of samples 56.0 kHz SPF
351	Number of samples 100 kHz + number of samples 178 kHz SPF
352	Number of samples in WB
353	Spare
354	
355	
356	
357	
358	
359	
360	